REGISTER

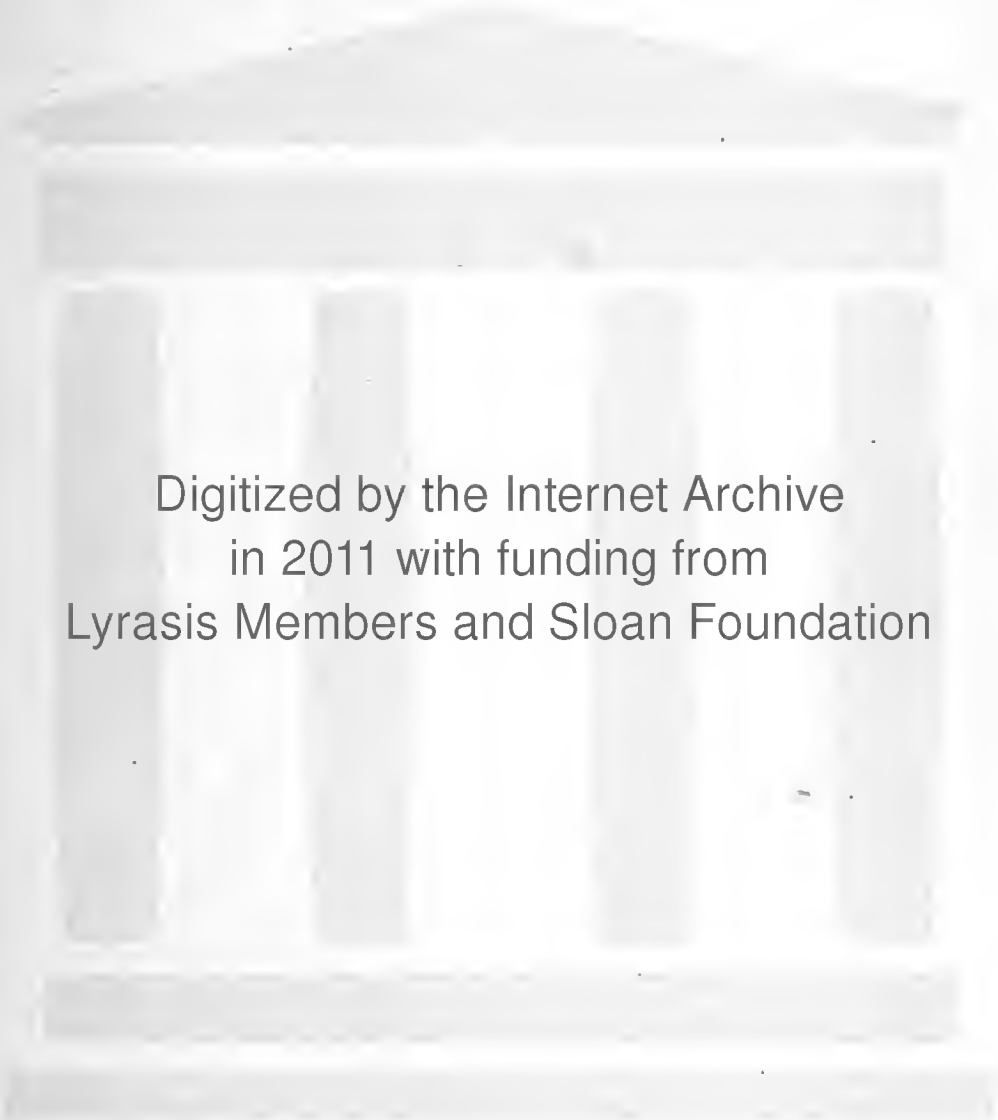
OF

THE LEHIGH UNIVERSITY,

1889-1890.

TUITION FREE.

SOUTH BETHLEHEM, PA.
1889.



REGISTER

OF

THE LEHIGH UNIVERSITY,

SOUTH BETHLEHEM, PA.,

1889-1890.

FOUNDED BY ASA PACKER.

TUITION FREE.

BETHLEHEM, PA.,
THE COMENIUS PRESS.
1890.

TABULAR ALMANAC.

1889.

JULY.

S	M	T	W	T	F	S
...	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	...	...	...
...	...	...	...	...	...	...

AUGUST.

S	M	T	W	T	F	S
...	...	...	...	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
...	...	...	...	...	...	...

SEPTEMBER.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	...	...	...	...	...
...	...	...	...	...	...	...

OCTOBER.

S	M	T	W	T	F	S
...	...	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	...	...
...	...	...	...	...	...	...

NOVEMBER.

S	M	T	W	T	F	S
...	...	...	...	...	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
...	...	...	...	...	...	...

DECEMBER.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	...	...	...	...
...	...	...	...	...	...	...

1890.

JANUARY.

S	M	T	W	T	F	S
...	...	...	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	...
...	...	...	...	...	...	...

FEBRUARY.

S	M	T	W	T	F	S
...	...	...	...	...	...	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	...
...	...	...	...	...	...	...

MARCH.

S	M	T	W	T	F	S
...	...	...	...	...	...	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	...	...	...	...	...

APRIL.

S	M	T	W	T	F	S
...	...	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	...	...	...
...	...	...	...	...	...	...

MAY.

S	M	T	W	T	F	S
...	...	...	...	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
...	...	...	...	...	...	...

JUNE.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	...	...	...	...	...
...	...	...	...	...	...	...

JULY.

S	M	T	W	T	F	S
...	...	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	...	...
...	...	...	...	...	...	...

AUGUST.

S	M	T	W	T	F	S
...	...	...	...	...	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	...	...	...	...	...	...

SEPTEMBER.

S	M	T	W	T	F	S
...	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	...	...	...	...
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OCTOBER.

S	M	T	W	T	F	S
...	...	...	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	...
...	...	...	...	...	...	...

NOVEMBER.

S	M	T	W	T	F	S
...	...	...	...	...	...	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	...	...	...	...	...	...

DECEMBER.

S	M	T	W	T	F	S
...	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	...	...	...
...	...	...	...	...	...	...

1891.

JANUARY.

S	M	T	W	T	F	S
...	...	...	...	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
...	...	...	...	...	...	...

FEBRUARY.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
...	...	...	...	...	...	...
...	..	...	...	...	...	...

MARCH.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	...	...	...	...
...	...	...	...	...	...	...

APRIL.

S	M	T	W	T	F	S
...	...	...	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	...	...
...	...	...	...	...	...	...

MAY.

S	M	T	W	T	F	S
...	...	...	...	...	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	...	...	...	...	...	...

JUNE.

S	M	T	W	T	F	S
...	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	...	...	...	...
...	...	...	...	...	...	...

CALENDAR.

1889-1890.

1889. Sept. 7, 9, 10,	Saturday, Monday and Tuesday,	Examinations for Admission.
Sept. 11,	Wednesday,	First Term begins.
Oct. 10,	Thursday,	Founder's Day.
Nov. 28,	Thursday,	Thanksgiving Day.
Dec. 18,	Wednesday,	First Term ends.
1890. Jan. 7, 8,	Tuesday and Wednesday,	Examinations for Admission to Second Term.
Jan. 8,	Wednesday,	Second Term begins.
Jan. 18,	Saturday,	Junior Prize Orations due.
Feb. 22,	Saturday,	Washington's Birthday.
Feb. 19,	Wednesday,	Ash Wednesday.
April 3,	Thursday,	Easter Holidays begin.
April 8,	Tuesday,	Easter Holidays end at 8¼ A.M.
May 26,	Monday,	University-Day Orations due.
May 28,	Wednesday,	Theses of Seniors due.
May 28,	Wednesday,	Senior Examinations begin
June 4,	Wednesday,	Annual Examinations begin.
June 7,	Saturday,	Senior Examinations end.
June 11, 12, 13,	Wednesday, Thursday and Friday,	Examinations for Admission.
June 15,	Sunday,	Baccalaureate Sermon.
June 17,	Tuesday,	Class Day.
June 18,	Wednesday,	Alumni Day.
June 19,	Thursday,	University Day.

1890-1891.

1890. Sept. 6, 8, 9,	Saturday, Monday, and Tuesday,	Examinations for Admission.
Sept. 10,	Wednesday,	First Term begins.
Oct. 9,	Thursday,	Founder's Day.
Nov. 27,	Thursday,	Thanksgiving Day.
Dec. 17,	Wednesday,	First Term ends.
1891. Jan. 6, 7,	Tuesday and Wednesday,	Examinations for Admission to Second Term.
Jan. 7,	Wednesday,	Second Term begins.
June 18,	Thursday,	University Day.

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PRESTON A. LAMBERT, B.A.,
Instructor in Mathematics.

FONGER DE HAAN, C.N.L.,
Instructor in Modern Languages.

LESTER P. BRECKENRIDGE, PH.B.,
Instructor in Mechanical Engineering.

HENRY S. JACOBY, C.E.,
Instructor in Civil Engineering.

*GEORGE F. DUCK, E.M.,
Instructor in Mining.

JOSEPH W. RICHARDS, M.A., A.C.,
Instructor in Metallurgy and Blowpiping.

LEWIS BUCKLEY SEMPLE, B.A.,
Instructor in Rhetoric.

R. M. HUSE, M.A.,
Instructor in Modern Languages.

JOHN J. FLATHER, PH. B.,
Instructor in Mechanical Engineering.

LIONEL R. LENOX, PH.B., F.C.S.,
Instructor in Quantitative Analysis and Industrial Chemistry.

JOSEPH F. MERKLE, C.E.,
Instructor in Civil Engineering.

PAUL J. DASHIELL, B.A.,
Instructor in Organic Chemistry.

ERNEST A. CONGDON, PH.B.,
Instructor in Qualitative Analysis and Assaying.

GEORGE W. SHERWOOD, B.A., C.E.,
Instructor in Civil Engineering.

RALPH M. WILCOX, PH.B.,
Instructor in Drawing.

RICHARD O. HEINRICH,
Instructor in Physics.

HARRY H. STOEK, B.S., E.M.,
Instructor in Mining and Geology.

* Resigned.

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Assistant,
CHARLES F. SEELEY.

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WILSON F. STAUFFER.

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STUDENTS.

Clas.—Classical Course.
L.S.—Latin-Scientific Course.
Sci.—Course in Science and Letters.
A.C.—Analytical Chemistry.
Arch.—Architecture.
C.E.—Civil Engineering.
E.M.—Mining Engineering.
M.E.—Mechanical Engineering.
Met.—Metallurgy.
E.E.—Electrical Engineering.

The students whose names are printed in *italics* are not clear of conditions.

GRADUATES.

	For Degree.	Residence.
James W. Anderson, B.S.,	E.M.,	Washington, D. C.
Samuel Erwin Berger, B.A.,	M.A.,	Richland Centre.
Albert Gallatin Brodhead, B.A., (Harvard University.)	C.E.,	Wilkes-Barre.
William Henry Dean, A.C.,	E.M., M.S.,	Wilkes-Barre.
Charles Estell Dickerson, jr.,	B.S., M.S.,	Mt. Hermon, Mass.
George Francis Duck, E.M.,	Ph.D.,	Rapid City, Dak.
Harvey Sheafe Fisher, B.A.,	M.A.,	Pottsville.
Samuel Wilson Frescoln, C.E.,	M.S.,	Reading.
Frederick Louis Grammer, B.S.,	E.M.,	Baltimore, Md.
Conrad Egbert Hesse, B.S.,	E.M.,	Washington, D. C.
Robert Browne Honeyman, B.S.,	E.M.,	Bethlehem.
Preston Albert Lambert, B.A.,	M.A.,	South Bethlehem.
Sylvanus Elmer Lambert, B.A.,	M.A.,	Philadelphia.
Lionel R. Lenox, Ph.B., (Columbia University.)	M.S.,	South Bethlehem.

	For Degree.	Residence.
Wilson Franklin More, B.A.,	M.A.,	Catasauqua.
George Spencer Patterson, E.M.,	M.S.,	Mahanoy City.
Albert George Rau, B.S.,	M.S.,	Bethlehem.
Arnold Karthaus Reese, B.S.,	E.M.,	Baltimore, Md.
Joseph William Richards, A.C.,	M.S.,	Bethlehem.
Edward Orth Robinson, B.A., (College of New Jersey.)	E.E.,	Allegheny City.
Lewis Buckley Semple, B.A.,	M.A.,	Bethlehem.
Martin D. Sibert, B.C.E., B.M.E., (University of Alabama.)	C.E.,	Gadsden, Alabama.
Arthur Moult Smyth, B.S.,	E.M.,	Philadelphia.
Joseph Kiddoo Surls, B.M.,	M.S.,	Anniston, Ala.
William Patterson Taylor, B.A.,	M.A.,	Philadelphia.
Augustus Thompson Throop,	C.E., M.S.,	Port Gibson, N.Y.
Clarence Walker, B.S.,	E.M.,	Pottsville.
Samuel Dexter Warriner, B.A., (Amherst College.)	E.M.,	Montrose.
John R. Wagner, M.E.,	E.M.,	Drifton.

SENIOR CLASS.

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Howard Emory Alcott,	M.E.,	Mt. Holly, N. J.
Thomas C. J. Baily, jr.,	C.E.,	Newark, N. J.
Frederick Richard Barrett,	C.E.,	Fort Marcy, N. M.
Edwin Herbert Beazell,	C.E.,	Chillicothe, Mo.
James W. Boyd,	C.E.,	Seek.
Adolph Cardenas,	C.E.,	Nicaragua.
William Phelps Cleveland,	A.C.,	Waterville, N. Y.
Frank Raymond Coates,	E.M.,	Philadelphia.

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Charles Ellery Coxe,	E.M.,	Reading.
James Barlow Cullum,	A.C.,	Meadville.
John Rose Davis,	C.E.,	Phœnixville.
John William DeMoyer,	C.E.,	Duncannon.
Clement Heyser Detwiler,	C.E.,	Ironbridge.
Delevan Emery,	A.C.,	Bradford.
Charles Edward Fink,	C.E.,	Harrisburg.
Frederick Elmer Fisher,	C.E.,	New York City.
Frank Roberts Fisher,	C.E.,	Philadelphia.
John George Fleck,	C.E.,	Philadelphia.
Howard Augustus Foering,	Sci.,	Locust Valley.
Ralph Goodman,	C.E.,	Philadelphia.
George Ellsworth Greene,	C.E.,	Rochester, N. Y.
Harry Walter Harley,	M.E.,	Gloucester, N. J.
David Garth Hearne,	C.E.,	Wheeling, W. Va.
*James S. B. Hollinshead,	E.M.,	Dayton, O.
Frederic Kidder Houston,	M.E.,	New York City.
William Vincent Kulp,	C.E.,	Norristown.
Henry Meyers Kurtz,	C.E.,	Shamokin.
Harry Kinzer Landis,	E.M.,	Landis Valley.
John Elmer Litch,	M.E.,	Steelton.
Thomas Smith Leoser,	A.C.,	New York City.
Robert Sayre Mercur,	E.M.,	Wilkes-Barre.
Charles Herbert Miller,	A.C.,	Huntingdon.
George Nauman, jr.,	C.E.,	Lancaster.
Robert Engler Neumeyer,	C.E.,	Bethlehem.
William Cassidy Perkins,	C.E.,	Williamsport.
Asa Emory Phillips,	C.E.,	Washington, D.C.
Alexander Potter,	C.E.,	Halifax, N. S.

*Excused from attendance.

	Course.	Residence.
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Edwin Jay Prindle,	M.E.,	Washington, D.C.
Wallace Carl Riddick,	C.E.,	Wake Forest, N. C.
John Stover Riegel,	M.E.,	Riegelsville, N. J.
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William Alston Stevenson,	M.E.,	Lewistown.
Theodore Alfred Straub,	C.E.,	Allegheny.
Francis Dupont Thomson,	M.E.,	Philadelphia.
Charles Cookman Tomkinson,	M.E.,	Harrisburg.
Claude Allen Porter Turner,	C.E.,	Lime Rock, R. I.
Aaron Howell Van Cleve,	C.E.,	Easton.
David Thomas Williams,	M.E.,	Catasauqua.
Herbert Wright,	M.E.,	Northampton, Mass.

JUNIOR CLASS.

	Course.	Residence.
Murray Blatchley Augur,	E.E.,	Washington, D. C.
Juan de la Rosa Barrios,	E.M.,	Bogota, U. S. Colombia.
John Mayall Beaumont,	M.E.,	Scranton.
Harry Weed Biggs,	C.E.,	Glendale, O.
James Edwin Boatrite,	C.E.,	Columbus, Ga.
Herman Stadiger Borhek,	E.E.,	Bethlehem.
William Young Brady,	Arch.,	Franklin.
George Briggs,	E.E.,	Scranton.
Jacob Burr Buckley,	E.E.,	Oxford, N. Y.
Emanuel Chao,	C.E.,	Cienfuegos, Cuba.

	Course.	Residence.
Charles Houghton Corbin,	A.C.,	Telluride, Col.
Edward Haviland Coxe,	C.E.,	Reading.
Warder Cresson,	M.E.,	Swarthmore.
Eric Doolittle,	C.E.,	Bethlehem.
Alban Eavenson,	A.C.,	Philadelphia.
Harry S. Eckert,	A.C.,	Reading.
Lester Hallett Ely,	A.C.,	New York City.
Juan de la Cruz Escobar,	M.E.,	Matanzas, Cuba.
Walter Lowe Fairchild,	E.E.,	Elmira, N. Y.
Walton Forstall,	E.E.,	Chicago, Ill.
Eugene Uz Gibbs,	M.E.,	Mt. Holly, N. J.
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Hermann Victor Hesse,	E.M.,	Bethlehem.
Ralf Ridgway Hillman,	E.M.,	Wilkes-Barre.
Paul Depue Honeyman,	E.E.,	Bethlehem.
John Turner Hoover,	Arch.,	Philipsburg.
Alexander Chambers Howard,	E.M.,	South Bethlehem.
Henry Kemmerling,	C.E.,	Scranton.
Amos Dey Kennedy, jr.,	E.E.,	Philadelphia.
Hermann Meriwether Knapp,	C.E.,	Louisville, Ky.
Harry Kramph,	C.E.,	North Platte, Neb.
Frederick Curtiss Lauderburn,	Clas.,	Hazleton.
Henry Lefevre,	E.M.,	Panama, U.S.Colombia.
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Joseph Simonson Lockwood,	E.E.,	Brooklyn, N. Y.
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George Hillard Lynch,	C.E.,	Wilkes-Barre.
Allan Moore Masser,	A.C.,	Scranton.
William David Matheson,	A.C.,	Brooklyn, N. Y.
Frank Anderson Merrick,	E.E.,	New Hope.
John Zollinger Miller,	E.E.,	Harrisburg.
George Smuller Mish,	C.E.,	Middletown.
Harry Timothy Morris,	M.E.,	Pottsville.
Alexander Leutze McClurg,	E.M.,	Chambersburg.
James Anderson McClurg,	E.M.,	Meadville.
Paul Mayo Paine,	C.E.,	Troy.
Edwin Addams Quier,	A.C.,	Reading.
Edgar Randolph Reets,	A.C.,	Wilkes-Barre.
Walter Freeman Rench,	C.E.,	Cumberland, Md.
Robert Schmitz,	C.E.,	Egg Harbor City, N. J.
Anton Schneider,	C.E.,	Summit Hill.
Leidy Rudy Shellenberger,	C.E.,	Benjamin.
Ira Augustus Shimer,	Clas.,	Redington.
Michael Druck Sohon,	A.C.,	Washington, D. C.
Horace Theodore Stilson,	C.E.,	Cleveland, Ohio.
R. Paul Stout,	M.E.,	Audenried.
William Sidney Topping,	L.S.,	Sagg, N. Y.
Domingo Anthony Usina,	C.E.,	Savannah, Ga.
Michael Neligan Usina,	E.E.,	Savannah, Ga.
Elias Vander Horst,	C.E.,	Charleston, S. C.
William Alder Webb,	M.E.,	Bethlehem.
George Edward Wendle,	E.E.,	Philadelphia.
Frank Shriver West,	A.C.,	Philadelphia.
Peyton Brown Winfree,	C.E.,	Lynchburg, Va.

SOPHOMORE CLASS.

	Course.	Residence.
William North Robins Ashmead,	Clas.,	Minersville.
George W. B. Asmussen,	C.E.,	Washington, D. C.
George Haldeman Atkins,	C.E.,	Pottsville.
Robert Ligget Baird,	C.E.,	Philadelphia.
Hugh Cunningham Banks,	E.E.,	Savannah, Ga.
Noble Banks,	E.M.,	Savannah, Ga.
Joseph Barrell,	E.M.,	New Providence, N. J.
John Young Bassell, jr.,	E.M.,	Leesburg, Va.
John Newbaker Bastress,	C.E.,	Sunbury.
John Bush Beck, Jr.,	M.E.,	Williamsport.
George Jones Bridgers,	C.E.,	Wilmington, N. C.
John Emery Bucher,	A.C.,	Hanover.
Charles Merritt Case,	E.M.,	Minneapolis, Minn.
George Price Case,	E.M.,	Minneapolis, Minn.
Henry Clark, jr.,	E.M.,	Montgomery City, Mo.
Philip Lothrop Cobb,	C.E.,	Cleveland, Ohio.
Samuel Dewey Cushing,	M.E.,	Washington, D.C.
Herman Haupt Davis,	M.E.,	Philadelphia.
Morgan Davis,	E.M.,	Mt. Carmel.
Heber Denman,	E.M.,	Kendall Creek.
Edwin Dodge,	E.M.,	Gouverneur, N. Y.
Daniel Edward Downey,	M.E.,	South Bethlehem.
Robert Arthur Downey,	C.E.,	Oswego, N. Y.
Percival Drayton,	M.E.,	Philadelphia.
Howard Weidener DuBois,	E.M.,	Philadelphia.
George Washington Engle,	E.M.,	Ashland.

	Course.	Residence.
Arthur Haldeman Fetters,	M.E.,	Barneston.
Thanlow Gjertsen,	C.E.,	Saxton.
John Adams Gruver,	Clas.,	Springtown.
Edwin Paul Hazel,	M.E.,	Cressona.
Julian Greene Hearne,	E.E.,	Wheeling, W. Va.
Charles Miller Hobbs,	M.E.,	Hulmesville.
Benjamin Williams Homans,	C.E.,	Brooklyn, N. Y.
William Lawall Jacoby,	M.E.,	South Bethlehem.
Alfred Emerson Jessup,	E.M.,	New York City.
Juan Jose Jimenez,	C.E.,	Aguadilla, Porto Rico.
William Edward Johnson,	Arch.,	Glastonbury, Conn.
John Elmer Jones,	E.M.,	Hazleton.
Robert Reed Kitchel,	M.E.,	South Bethlehem.
Wilbur Heath Kramer,	Clas.,	New Iberia, La.
Sylvester Welch Labrot,	C.E.,	Frankfort, Ky.
Alfred Emory Lister,	M.E.,	Carbondale.
William John Lloyd,	E.E.,	Philadelphia.
John Taylor Loomis,	E.E.,	Philadelphia.
James Alvan Macauley,	C.E.,	Washington, D. C.
Joseph Macfarland,	A. C.,	Washington, D. C.
Henry Lewis Manley,	E.M.,	Ashland.
Raymond Masson,	E.E.,	Hammondsport, N. Y.
Archibald Stewart Maurice,	C.E.,	Athens.
Charles Watson Meade,	Clas.,	Oswego, N. Y.
Edward James Millar,	C.E.,	West Broome, P.Q., Can.
Charles Tyler Mosman,	E.E.,	Beverly, Mass.
Frank Hamilton McCall,	M.E.,	Binghamton, N. Y.
Matthew McClung, jr.,	C.E.,	Knoxville, Tenn.
Robert Blum Olney,	C.E.,	Charleston, S. C.
Henry Orth, jr.,	E.M.,	Washington, D. C.
Ramon Eckhart Ozias,	E.E.,	Quakertown.

	Course.	Residence.
William Taylor Patterson,	E.E.,	Mahanoy City.
Frank Everett Pratt,	C.E.,	Nicholson.
James Pius Rafferty,	M.E.,	Chicago, Ill.
Frank De Witt Randolph,	M.E.,	Plainfield, N. J.
Robert Swenk Rathbun,	E.M.,	Allentown.
Edwin Clark Reynolds,	C.E.,	Providence, R. I.
Samuel Arthur Rhoads,	E.E.,	Birdsboro.
John Ira Riegel,	C.E.,	South Bethlehem.
Edwin Gray Rust,	M.E.,	Leesburg, Va.
John Bonner Semple,	A.C.,	Pittsburgh.
Edward Hagan Shaw,	M.E.,	Philadelphia.
Cass Knight Shelby,	M.E.,	Grand Rapids, Mich.
James Causten Shriver,	E.M.,	Cumberland, Md.
Charles Henry Simpson,	C.E.,	Pensacóla, Fla.
Oscar Emmerson Smith,	C.E.,	Portsmouth, Va.
Philip Henry Smith,	E.E.,	Parsippany, N. J.
Robert Jones Snyder,	M.E.,	Bethlehem.
John Stewart,	E.M.,	Lonaconing, Md.
Thomas Cedwyn Thomas,	C.E.,	Wilkes-Barre.
Lester Warren Walker,	E.E.,	North Platte, Neb.
David Hykes Witmer,	C.E.,	Annville.
Frederic Wittman,	A.C.,	Lanark.
Charles Oaks Wood,	M.E.,	Chambersburg.
Byron Edgar Woodcock,	E.M.,	Altoona.

FRESHMAN CLASS.

	Course.	Residence.
Joseph Weaver Adams,	M.E.,	Bethlehem.
Harry Doughten Appleby,	C.E.,	Wilmington, Del.
Miltiades Themistocles Armas,	C.E.,	Trebizond, Asia Minor.
Harry Jacob Atticks,	E.E.,	Lisburn.
George Thomas Bache,	E.M.,	Nanticoke.
David Balliet,	C.E.,	Normal Square.
Joseph Clinton Ballou,	A.C.,	Becket, Mass.
Charles Bartles, jr.,	E.M.,	Williamsport.
Clarence Earle Belfield,	E.E.,	Philadelphia.
Carville Dickinson Benson,	C.E.,	Arbutus, Md.
Edward Keating Bishop,	E.E.,	Chicago, Ill.
William Irvin Boyd,	C.E.,	Washington, D. C.
Samuel Branson,	M.E.,	Wrightstown, N. J.
Fred. Edgar Bray,	C.E.,	Industry.
Alfred Tennyson Brown,	E.E.,	Rising Sun, Ind.
Rezeau Blanchard Brown,	M.E.,	Somerville, N. J.
George Stuart Wylie Brubaker,	E.E.,	Lancaster.
Gilbert Forbes Burnett,	Sci.,	New Providence, N. J.
Ellis Buchanan Byllesby,	L.S.,	Allegheny.
Langston Byllesby,	Sci.,	Allegheny.
John Salmon Carman,	A.C.,	Washington, D.C.
Frederick Cowan Carnaghan,	E.M.,	New York City.
George Edwin Chamberlain,	A.C.,	Pittston.
Morris Llewellyn Cooke,	M.E.,	South Bethlehem.
Warren Fellman Cressman,	C.E.,	Sellersville.
John Purviance Culbertson, jr.,	E.E.,	Chambersburg.

	Course.	Residence.
George Milton Curtis, jr.,	L.S.,	New York City.
Samuel Philip Curtis,	C.E.,	Penn Yan, N. Y.
William Russel Davis,	C.E.,	Walpole, N. H.
Walter Joseph Dech,	Clas.,	Bethlehem.
Jacob De Haan,	E.E.,	Netherlands.
Alden Brown Diven,	C.E.,	Elmira, N. Y.
Charles Malcolm Douglass,	Clas.,	Belvidere, N. J.
Charles Hazard Durfee,	E.E.,	Fall River, Mass.
Harry Clifford Eddy,	E.E.,	Morristown, N. J.
James Marshall Edgar,	E.E.,	Chambersburg.
John Jay Edson, jr.,	C.E.,	Washington, D. C.
Bernard Dennis Enright,	A.C.,	South Bethlehem.
Henry Brown Evans,	M.E.,	Dayton, O.
Alfred Howell Exton,	C.E.,	High Bridge, N. J.
Edward Fargason,	M.E.,	Memphis, Tenn.
Frederic Percival Farrar,	A.C.,	London, England.
Robert Ferriday,	C.E.,	South Bethlehem.
Henry Cowan Blair Finley,	E.M.,	Chattanooga, Tenn.
Richard Daniel Floyd,	Sci.,	Milton, Mass.
George Harwood Frost,	M.E.,	Plainfield, N. J.
Frederick Pardee Fuller,	E.E.,	Scranton.
Robert Foster Gadd,	C.E.,	Sudlersville, Md.
Charles Willits Gearhart,	E.E.,	Danville.
Albert Ross Gee,	E.E.,	Fall River, Mass.
Gustavus Adolphus Gessner, jr.,	E.M.,	Fremont, O.
Lyle Nugent Gillis,	C.E.,	Alexandria, Va.
Harvey Hartzell Godshall,	A.C.,	Landsdale.
Samuel Laury Graham, jr.,	E.M.,	Pinewood, Tenn.
John Grant,	A.C.,	Margaretville, N. Y.
Samuel Wilbur Grubb,	C.E.,	Philadelphia.
Albert Arthur Guilbert,	E.E.,	Racine, Wis.

	Course.	Residence.
Peter Wilson Hairston,	E.E.,	Walnut Cove, N. C.
George Hervey Hallett,	Clas.,	Pottsville.
John Nicholas Halter,	C.E.,	Los Angeles, Cal.
Lee Stout Harris,	C.E.,	Silver Brook.
Claude Sanford Haynes,	C.E.,	Elmira, N. Y.
Robert Culbertson Hays Heck,	M.E.,	Heckton Mills.
Howard Bright Heller,	M.E.,	South Bethlehem.
Bayly Hipkins,	M.E.,	Oakland, Md.
William Geer Hitchcock,	E.E.,	New York City.
George Perry Hodgman,	M.E.,	Wilmington, Del.
William Emley Holcombe,	E.E.,	Lambertville, N. J.
Hartley Howard, jr.,	E.E.,	Pittsburgh.
Rollin Germaine Hubby,	E.E.,	Cleveland, O.
Lester Mead Hubby,	L.S.,	Cleveland, O.
Edward Blackstone Hurst,	C.E.,	Cincinnati, O.
George Cass Hutchinson,	M.E.,	Sewickley.
Turie Seibert Ickes,	C.E.,	Newport.
Charlie Borrows Jacobs,	E.M.,	Slatington.
Fred. Kittredge Jenney,	L.S.,	Kansas City, Mo.
Guillemo Enrique Jimeno,	C.E.,	New York City.
William Stricklar Jones,	E.M.,	Greensburg.
Sylvester Dwight Judd,	E.M.,	West Orange, N. J.
Charles Lincoln Keller,	M.E.,	Dubuque, Iowa.
Henry Whitman Kern,	M.E.,	Chicago, Ill.
Herman Eugene Kiefer,	A.C.,	Altoona.
Schuyler Brush Knox,	C.E.,	CarthageLanding,N.Y.
Louis John Krom,	A.C.,	Plainfield, N. J.
Harry Donaldson Leopold,	C.E.,	Tamaqua.
Frank Sigismund Loeb,	A.C.,	Columbia.
John Douglas Lowry,	E.E.,	Washington, D. C.
Clarence Oliver Luckenbach,	M.E.,	Bethlehem.

	Course.	Residence.
William Price Marr,	E.E.,	Shamokin.
John Vansickle Martenis,	E.E.,	South Bethlehem.
Frederick Chandler Mathewson,	E.M.,	Pomfret, Conn.
Joseph Oscar Mathewson, jr.,	E.M.,	Augusta, Ga.
George Holbrooke Maurice,	C.E.,	Athens.
James Edgar Miller,	C.E.,	Chicago, Ill.
Walter Chambers Miller,	E.M.,	Sewickley.
Rudolph Clarence Möllmann,	E. E.,	Germantown.
William Frederick Mylander,	C.E.,	Baltimore, Md.
Hiram Dryer McCaskey,	E.M.,	Fort Assineboine, Mont.
Francis Marion McCullough,	E.E.,	Altoona.
John Douglas McPherson, jr.,	E.E.,	Washington, D. C.
Harvey Frankenfield Nase,	C.E.,	Springtown.
Alphonso Robert Nicholson,	A.C.,	Jenkintown.
Clinton Ledyard Olmsted,	C.E.,	Eagle Village, N. Y.
Charles Joseph O'Neill,	E.E.,	Washington, D. C.
Miguel Orozco, jr.,	C.E.,	Colombia, S. A.
Charles William Parkhurst,	E.E.,	Hammonton, N. J.
Duncan White Patterson,	M.E.,	Safe Harbor.
John Gates Peck,	C.E.,	Stow, Mass.
Wilbur Orton Polhemus,	C.E.,	Nyack, N. Y.
Stephen Collins Potts,	A.C.,	Altoona.
Mervin Paul Randolph,	E.E.,	Atglen.
Raymond Bernard Randolph,	A.C.,	Montclair, N. J.
Charles Allen Rea,	E.E.,	Mill Green, Md.
Joel Howard Reber,	E.E.,	Allentown.
John Graham Reid,	C.E.,	Danville.
Harold Kinney Rice,	M.E.,	Addison, N. Y.
James Clement Richardson, jr.,	E.E.,	Glendale, O.
Lewis Daniel Rights,	C.E.,	Tahlequah, Ind. Ty.
George William Ritchey,	L. S.,	Pittsburgh.

	Course.	Residence.
Samuel Neely Riter,	M.E.,	Stoops Ferry.
William Locke Rockwell,	A.C.,	Plainfield, N. J.
Charles Beecher Rutter,	E.M.,	Lansford.
Clement Clarence Rutter,	C.E.,	Lansford.
Frederic Brittan Sage,	E.E.,	Hackensack, N. J.
Martin Luther Saulsbury,	C.E.,	Ridgely, Md.
Edmund Munroe Sawtelle,	M.E.,	Washington, D. C.
Joseph A. Schloss,	A.C.,	Elmira, N. Y.
Armin Schotte,	C.E.,	New York City.
Frank Schutte,	A.C.,	Philadelphia.
Eugene Schwinghammer,	E.E.,	Egg Harbor City, N. J.
Thomas Elvin Semmel,	Sci.,	Kreidersville.
William Frederick Semper,	A.C.,	Philadelphia.
Christian Thomsen Shannon,	E.E.,	Pittsburgh.
Alexander Beatty Sharpe,	E.M.,	Steubenville, O.
Adelbert Sheldon,	C.E.,	Royalton, N. Y.
Oswin Weinberger Shelly,	Arch.,	Milford Square.
Carroll Bradford Smith,	E.E.,	Norristown.
Clarence Galen Smith,	A.C.,	Cleveland, O.
Floyd Kipp Smith,	C.E.,	Bayonne, N. J.
Noel W. Smith,	C.E.,	Williamsport.
Richard Andrew Lee Snyder,	E.E.,	Carlisle.
Edward Augustus Soleliac,	M.E.,	Allentown.
Alfred Earnest Speirs,	Clas.,	Bethlehem.
Charles Paxton Stackhouse,	M.E.,	Shickshinny.
George Stern,	Clas.,	Frostburg, Md.
William Renick Stinemetz,	E.E.,	Washington, D. C.
David Reese Stockton,	E.E.,	Phœnixville.
Charles Andrew Straw,	E.M.,	Wilkes-Barre.
John Taylor, jr.,	A.C.,	Bethlehem.
Wilson Jones Taylor,	C.E.,	Edgmont.

	Course.	Residence.
Charles Wickliffe Throckmorton,	E.E.,	Rosebank, N. Y.
John Harry Tonkin,	C.E.,	Wilkes-Barre.
Lewis Esler Troutman,	E.E.,	Pottsville.
Orson William Trueworthy,	E.E.,	Washington, D. C.
John Moore Van Cleve,	E.E.,	Sewickley.
Jacob Von Maur,	C.E.,	West Pittston.
Fred. Conover Warman,	C.E.,	Washington, D. C.
Winfield Lemuel Warner,	M.E.,	Brooklyn, N. Y.
William J. Weatherby,	M.E.,	Swedesboro, N. J.
James Maxwell Welch,	M.E.	Uhrichsville, O.
Walter Wynne Wentworth,	E.E.,	Slatington.
Charles Drake Westcott,	E.E.,	Washington, D. C.
James Horatio Westcott, jr.,	Sci.,	Wilmington, Del.
Henry Blackstone Wilkins,	A.C.,	Baltimore, Md.
John Lewis Williams,	E.M.,	Wilkes-Barre.

SPECIAL STUDENTS.

	Course.	Residence.
William Alexander Auchinvole,	A.C.,	Harrisburg.
Hanson Entriker Atkins,	M.E.,	Pottsville.
Allen Harwood Babcock,	A.C.,	Oakland, Cal.
William Williams Blunt,	E.E.,	Goshen, Md.
Ezekiel McNeal Bond,	E.E.,	Bolivar, Tenn.
Frederick Stanley Camp,	E.E.,	Brooklyn, N. Y.
Charles Joseph Coll,	C.E.,	Broad Ford.
Harold Beecher Conant,	E.M.,	New York City.
George Edmund Gay,	E.M.,	Pottsville.
Cornelius Silsby Hawkins,	E.E.,	Fall River, Mass.
Augustus Francis Horne,	A.C.,	Allentown.

	Course.	Residence.
Christopher Gadsen Howe,	C.E.,	Charleston, S.C.
Hagime Ichikawa,	A.C.,	Tokio, Japan.
Albert Edward Juhler,	A.C.,	Pomeroy, Ohio.
John LeDroit Langdon,	E.E.,	Buffalo, N. Y.
Charles Douglass Mather,	M.E.,	Kincardine, Ont., Can.
Charles Wiltberger Platt,	A.C.,	New York City.
Thomas Clement Rafferty,	E.E.,	Chicago, Ill.
Alexander Wand,	E.M.,	Danville.
Robert Jacob Yost,	A.C.,	South Bethlehem.
Roger Hanson Zimmerman,	E.M.,	Louisville, Ky.

SUMMARY OF STUDENTS BY CLASSES AND COURSES.

	Graduates.	*Seniors.*	*Juniors.*	*Sophomores.*	*Freshmen.*	*Specials.*	*Totals.*
Classical,	7	1	2	4	5	—	19
Latin-Scientific,	2	—	1	—	5	—	8
Science and Letters,	—	1	—	—	5	—	6
Civil Engineering,	4	29	22	22	44	2	123
Mechanical Eng.,	—	12	9	19	24	2	66
Mining Eng.,	14	5	9	19	17	4	68
Electrical Eng.,	1	—	13	11	44	6	75
Analytical Chem.,	1	6	11	4	20	7	49
Architecture,	—	—	2	1	1	—	4
Totals,	29	54	69	80	165	21	418

SUMMARY OF STUDENTS BY STATES.

New Hampshire,	1
Vermont,	1
Massachusetts,	9
Connecticut,	3
Rhode Island,	1
New York,	41
Pennsylvania,	211
New Jersey,	27
Delaware,	3
Maryland,	15
District of Columbia,	22
Virginia,	5
West Virginia,	2
North Carolina,	3
South Carolina,	3
Georgia,	6
Alabama,	2
Florida,	1
Louisiana,	1
Ohio,	15
Indiana,	1
Illinois,	6
Wisconsin,	2
Minnesota,	2
Michigan,	1
Iowa,	1
Missouri,	3

Kentucky,	2
Tennessee,	5
Kansas,	1
Louisiana,	1
Nebraska,	2
Dakota,	1
Colorado,	1
Montana,	1
California,	2
New Mexico,	1
Indian Territory,	1
Canada,	3
Cuba,	2
United States of Columbia,	3
Porto Rico,	1
England,	1
Netherlands,	1
Asia Minor,	1
Japan,	1
Total,	418

THE LEHIGH UNIVERSITY.

ORIGIN.

The Hon. ASA PACKER, of Mauch Chunk, during the year 1865, appropriated the sum of Five Hundred Thousand Dollars, to which he added one hundred and fifteen acres of land in South Bethlehem, to establish an educational Institution in the rich and beautiful Valley of the Lehigh. From this Foundation rose THE LEHIGH UNIVERSITY, incorporated by the Legislature of Pennsylvania in 1866. In addition to these gifts, made during his life-time, Judge Packer by his last will secured to the University an endowment of $1,500,000, and to the University Library one of $500,000.

DESIGN.

The original object of Judge Packer was to afford the young men of the Lehigh Valley a complete education, technical, literary and scientific, for those professions represented in the development of the peculiar resources of the surrounding region. In furtherance of this purpose instruction is liberally provided in Civil, Mechanical, Mining and Electrical Engineering, Chemistry, Metallurgy, Architecture, and in all needful collateral studies. A School of General Literature is also established and thoroughly equipped, with three departments, called respectively the Classical, the Latin-Scientific, and that of Science and Letters. These departments are kept up to the standard, and the requirements for entrance are the same as those of our best Classical and Literary institutions.

FREE TUITION.

All these educational facilities are provided without charge. Through the generosity of the Founder, the Trustees were enabled, in 1871, to declare tuition FREE in all

branches and classes. The Lehigh University is open to young men of good character and suitable preparation from every part of our own land and of the world. To this fact the attention of the pupils of our public schools and of the graduates of classical institutions is especially called. Thus is offered, *without charge*, every facility for studying the professions of the Civil, Mechanical, Mining and Electrical Engineer, and of the Metallurgist, Analytical Chemist and Architect. In the Classical and Scientific departments of the School of General Literature instruction is given in the Classics, Sciences and Letters.

PUBLIC WORSHIP.

Prayers are held in the Packer Memorial Church of the University every morning and all students are required to be present.

Divine Service is held on every Sunday morning in the Church. The service is according to the forms of the Protestant Episcopal Church, under whose auspices the University was placed by its Founder. Attendance is required of every student, except in case of those connected with other religious bodies, to whom the President will grant permission at the beginning of each term (if requested by the parent or guardian, or by the student himself if he be 21 years of age) to attend during that term the place of worship of the body with which he is connected, where attendance on Sunday morning will be required.

SITE.

The situation of the Institution is healthful and beautiful. The region is famous for its railway and manufacturing enterprises; it possesses some of the richest iron and coal mines in our land, and thus gives the students rare facilities for confirming the teachings of the recitation room by the observation of the eye.

The University Buildings are about a half-mile from the depot, at the junction of the Lehigh Valley and North Pennsylvania Railroads. New York is ninety-two, and Philadelphia fifty-four miles distant.

BUILDINGS.

PACKER HALL,

named after the Founder, stands seven hundred feet back of Packer Avenue, at the base of the South Mountain. It is built of stone, and contains Lecture and Recitation Rooms, the Drawing Rooms and the Museum of Geology and Natural History.

THE CHEMICAL LABORATORY

is thoroughly fire-proof, is built of sandstone, and is 219 feet in length by 44 in width.

There are two principal stories and a basement. The upper floor is occupied by the quantitative and the qualitative chemical laboratories, the former accommodating 48 and the latter 84 students. These rooms are 20 feet in height, and are well lighted and ventilated. A laboratory for industrial chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a recitation room, a chemical museum and laboratories for organic, physiological, agricultural and sanitary Chemistry.

In the basement is the large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis, also rooms containing the apparatus for several processes in industrial chemistry, the engine and air-pump for vacuum filtration, a store room and the toilet.

A photographic laboratory is located in the third story of the central portion of the building.

THE METALLURGICAL LABORATORY

contains a lecture room, a blowpipe laboratory for class instruction in blowpipe analysis and in the practical determination of crystals and minerals, a museum for mineralogical and metallurgical collections, a mineralogical laboratory provided with a Fuess reflecting goniometer, a polariscope, a Groth's "universal apparat" and a Rosenbusch polarizing microscope, a dry laboratory provided with furnaces for solid fuel and for gas with natural draught and with blast,

and a wet laboratory for ordinary analytical work. It is arranged for the instruction of classes in the courses of mineralogy, metallurgy and blowpipe analysis of the regular curriculum, and to afford facilities to a limited number of advanced students for familiarizing themselves with the methods of measurement and research employed in mineralogy and metallurgy, and for conducting original investigations in these departments of science.

THE PHYSICAL LABORATORY

consists of three stories. A large lecture room, with a seating capacity of 150, occupies a portion of the second and third floors. It is well lighted and adapted to its purposes. On the remainder of these floors are two rooms, each 40 feet long, for Heat and Light laboratories, a dark room for photographic work, spectroscopic and apparatus rooms and the private laboratories of the Instructors.

The lower floor is devoted to the use of the students in Electricity. A large room nearly 40 feet square is used as the Electrical Laboratory. There are smaller rooms for photometric and spectroscopic work, also reading, balance, apparatus and engine rooms. On this floor a 12 horse-power high speed engine and a dynamo supply two systems of electric lights, one of 25 incandescent lamps, the other of four arc lights, for practical tests in the Electrical Laboratory and for experimental purposes in the lecture room above. In the cellar are battery, store rooms, etc.

The tower and two rooms in the east end of Christmas Hall have been given to the Department of Physics and will be equipped as a Meteorological Observatory.

THE SAYRE OBSERVATORY.

Near Brodhead Avenue is the Sayre Observatory, the gift of Robert H. Sayre, Esq., of South Bethlehem, containing an equatorial and a zenith telescope, transit instrument and astronomical clock.

THE UNIVERSITY LIBRARY.

To the east of Packer Hall is the University Library, erected by the Founder in memory of Mrs. Lucy Packer Linderman, his daughter.

THE GYMNASIUM

is a handsome and spacious structure, built and equipped with the utmost thoroughness. It is furnished with the best patterns of gymnastic apparatus, besides Dr. Sargent's system of Developing Appliances. It is provided with hot and cold water; tub, sponge and shower baths, and 389 clothes closets. Opportunities for recreation and amusement are provided in the bowling alleys. It is under the immediate care of a skilled and competent Director.

All students are required to undergo a physical examination before being allowed the use of the Gymnasium, and this examination will be repeated once each year during their stay at the University. The proper exercise is prescribed and is required of every student. The aim of the institution is to promote a harmonious, symmetrical development best suited to the individual condition of the student.

EXPENSES.

Tuition is FREE in all branches and classes. Books, materials, paper, pencils, chemical materials used in the analytical laboratories and drawing instruments are furnished by the student. Materials consumed in the analytical laboratories are furnished to the student by the University at cost prices, their value being covered by a deposit made at the opening of that term in which the laboratory work is to be done.

Rooms and Board can not be had in University buildings, but can readily be obtained in many private houses.

The following is an estimate of the necessary expenses for the collegiate year, clothing and traveling not included:

Board for 40 weeks, . . .	from $160 to $200
Room-rent, with fuel and lights .	40 " 80
Care of room and use of furniture,	5 " 20
Washing and incidentals, . . .	20 " 40
Books, stationery, etc., . . .	25 " 50
Total, ...	$250 to $390

NOTE.—If clubs be formed the cost of board need not exceed $3.50 per week.

ADMISSION OF STUDENTS.

The Register is intended to give all necessary information concerning the admission of students. Application may be made to the President of the University if information is desired which is not given in the Register.

DATE OF EXAMINATIONS.

Examinations for admission to the University are held at the opening of each term, and also in June at the close of the Academic year.

The examinations for 1890 will be on Tuesday and Wednesday, January 7 and 8, for admission to the *second term;* on Wednesday, Thursday and Friday, June 11, 12 and 13, and on Saturday, Monday and Tuesday, September 6, 8 and 9, for admission to the first term. No other examinations for entrance will be held, except for good cause, and all applicants *must* be in attendance at 9 o'clock on the morning of the first day.

The examinations are held in the following order:

First Day.—English Grammar, 9 A.M.; Geography, 11.30 A.M.; United States History, 2 P.M.; Physical Geography, 4 P.M.

Second Day.—Geometry, 9 A.M.; Arithmetic, 2 P.M.; Algebra, 3.30 P.M.

Third Day.—Latin and Roman History, 9 A. M.; Elementary Physics, 9 A.M.; Greek and Greek History, 2 P.M.

CHARACTER OF THE EXAMINATIONS.

The examinations are rigorous and cover the entire ground laid down in the following scheme. They are all conducted in writing, supplemented by an oral examination at the option of the examiner.

Each candidate for admission must be at least sixteen years of age and must present a testimonial of good moral

character from his last Instructor, or from the School or Institute to which he last belonged, or from some reputable citizen of the community in which he lives.

Candidates for admission to

THE CLASSICAL COURSE

will be examined in the following subjects :

1. *English Grammar*, including composition, spelling and punctuation.
2. *Geography*, general and political.
3. *History of the United States*, including the *Constitution*.
4. *Arithmetic*, including the metric system of weights and measures.
5. *Algebra*, Fundamental Principles. Factoring. Least Common Multiple. Greatest Common Divisor. Fractions. Involution. Evolution. Radicals. Imaginary Quantities. Equations of the First and Second Degrees. Ratio. Proportion and Progressions.

[Olney's University Algebra is recommended, as it is the text-book used in the University.]

6. *Geometry*, Fundamental Principles. Rectilinear Figures. The Circle. Proportional Lines and Similar Figures. Comparison and Measurement of the Surfaces of Rectilinear Figures.

[Chauvenet's Geometry, (four books) is recommended, as it is the text-book used in the University.]

7. *Physical Geography.*
8. *Latin Grammar.*
9. *Cæsar*, four books of the Gallic war.
10. *Cicero*, six orations, including the four against Catiline.
11. *Vergil*, the first six books of the Aeneid, including Prosody.
12. The translation, at sight, of passages from Cæsar and Cicero.
13. The translation of English into Latin. (As special importance is given this part of the examination, it is suggested to teachers that they connect exercises in making

Latin, both oral and written, with all the studies of the preparatory course.)

14. *Roman History.* Creighton's Primer of Roman History is suggested as indicating the amount required.

15. *Greek Grammar.*

16. *Xenophon*, Anabasis, four books.

17. *Homer*, Iliad, first three books, including Prosody. The Catalogue of Ships may be omitted.

18. The translation, at sight, of a passage from some work of Xenophon.

19. *Greek History.* Fyffe's Primer of Greek History is suggested.

20. Writing Greek with accents.

The pronunciation of Greek according to the written accents is followed in the University, and it is desirable that students preparing to enter be taught this system.

Latin is pronounced according to the so-called Roman Method.

THE LATIN-SCIENTIFIC COURSE.

Candidates for admission to this course must present the first fourteen of the above requirements, but will substitute for the Greek sections (numbers 15–20 inclusive) the following:

21. *Geometry*, Regular Polygons. Measurement of the Circle. Maxima and Minima of Plane Figures, and Plane and Polyhedral Angles; these constituting the subject matter of Books Five and Six of Chauvenet's Geometry.

THE COURSE IN SCIENCE AND LETTERS.

Candidates for admission to this course are examined in all the subjects demanded of those entering the Latin-Scientific Course, except the Latin and Physical Geography sections (numbers 7 to 14 inclusive). They will also present the following:

22. *Elementary Physics.*

[Avery's Elements of Natural Philosophy (revised edition) is recommended.]

THE SCHOOL OF TECHNOLOGY.

Candidates for admission to the Courses in Civil Engineering, Mechanical Engineering, Mining and Metallurgy, Electrical Engineering, Chemistry and Architecture will be examined in the following subjects:

1. *English Grammar*, including composition, spelling and punctuation. It is recommended that candidates have a knowledge of Latin Grammar, although an examination in it is not required for any courses except the Classical and the Latin-Scientific.

2. *Geography*, general and political.

3. *History of the United States*, including the *Constitution*.

4. *Arithmetic*, including the metric system of weights and measures.

5. *Algebra*, Fundamental Principles. Factoring. Least Common Multiple. Greatest Common Divisor. Fractions. Involution. Evolution. Radicals. Imaginary Quantities. Equations of the First and Second Degrees. Ratio. Proportion and Progressions.

[Olney's University Algebra is recommended, as it is the text-book used in the University.]

6. *Geometry*, Fundamental Principles. Rectilinear Figures. The Circle. Proportional Lines and Similar Figures. Comparison and Measurement of the Surfaces of Rectilnear Figures. Regular Polygons. Measurement of the Circle. Maxima and Minima of Plane Figures, and Plane and Polyhedral Angles; these constituting the subject matter of the first six books of Chauvenet's Geometry.

[Chauvenet's Geometry is recommended, as it is the text-book used in the University.]

7. *Elementary Physics.*

[Avery's Elements of Natural Philosophy (revised edition) is recommended.]

Division of Entrance Examinations.

Candidates for admission to the Freshman Class may pass all the examinations *at once* in June, or in September, or may take them in *two consecutive years*. In the latter case for the Technical courses and the course in Science

and Letters, candidates may present themselves for examination in the first year in the following subjects: English Grammar, Geography, History of the United States, and Arithmetic. No credit will be given unless the candidate has passed satisfactorily in at least three subjects at one examination.

The examinations in Algebra, Geometry and Physics must be passed in June or September of that year in which the candidate proposes to enter the University.

In the Latin-Scientific and Classical courses candidates may present themselves for examination in the first year in the following subjects: English Grammar, Geography, History of the United States, Arithmetic, Physical Geography, and Roman History. No credit will be given unless the candidate has passed at least four of the subjects at one examination.

The examination in Latin may also be divided, but no credit will be given unless the candidate has passed in at least three of the topics specified at one examination. The examination in the remaining subjects must be passed in June or September of that year in which the candidate proposes to enter the University.

Candidates intending to enter the University in September are advised to present themselves for examination in June; if they are not fully prepared at that time they will receive credit for the examinations then satisfactorily passed.

CONDITIONAL ADMISSION.

A candidate failing to pass in one or more of the subjects required for admission may, at the discretion of the Faculty, be admitted to his class conditionally, to make up his deficiencies by extra study. When they are made up, he will be received into full standing in his class.

SPECIAL STUDENTS.

Young men of advanced standing who do not desire to take a full regular course can enter and select special shorter courses, with the sanction of the Faculty; but in all cases satisfactory examinations must be passed upon the subjects required for entrance to the Freshman class.

ADMISSION TO ADVANCED STUDIES.

Candidates for admission to advanced studies *in any course* are required to pass, *in addition to the entrance examinations for that course*, examinations in the work already done by the classes which they desire to enter. These examinations are held on the same days as those for entrance to the Freshman class.

The additional subjects may be found in the program of studies.

A diploma or, in so far as it covers the subjects required for entrance, a certificate of studies taken at another College will be received in lieu of the *Primary Entrance Examinations only.*

ADMISSION TO THE POST GRADUATE COURSE.

Students of this University who have taken their *first* degree, and others, on presenting a diploma of an equivalent degree conferred elsewhere, are admitted to advanced studies, according to the plan to be found in the Register under the general subject of Graduate Students.

PREPARATORY SCHOOL CERTIFICATES

are not accepted so as to dispense with the primary entrance examinations.

NOTE.—The acceptance of a certificate as evidence of proficiency in lieu of examination, is at the discretion of each Professor as to the subjects in his department.

PROGRAM OF STUDIES,

Showing the number of exercises per week for each subject, and the Text-books used.

The following is presented as the general program of instruction, subject to such modifications from time to time as the Faculty may deem expedient, with the approval of the Trustees.

The names of the text-books studied are generally mentioned. The number of exercises per week in each subject is indicated by the figure in parentheses immediately following.

Two hours of Drawing, three of work in the Laboratory, or three of practice in the field, are regarded as equivalent to a recitation or lecture of one hour's duration.

SCHOOL OF GENERAL LITERATURE.

There are three courses in the School of General Literature of the University.

I. The Classical includes all that is prescribed in our best institutions for the degree of Bachelor of Arts (B.A.). It covers full instruction in Greek, Latin, English, French and German, Mathematics, Astronomy, Physics, Chemistry, Geology, Physiology, Hygiene, History, Ethics, Philosophy, Political Economy and Constitutional Law.

II. The Latin-Scientific Course differs from the first in omitting Greek, taking in its place an increased amount of the Modern Languages and of Mathematics. Students completing this Course receive the degree of Bachelor of Science (B.S.).

III. The Course in Science and Letters, for which the same degree is given as for the last mentioned, contains no Latin or Greek, but furnishes instead extended instruction

in French and German, History, General Literature, Mathematics and General Science.

Instruction in all of these courses is given both by recitations and lectures.

DESCRIPTION OF THE COURSES.

GREEK.—During the first term of Freshman year, the class reads several books of the Odyssey, giving attention to Epic forms and syntax, to prosody and scanning and to Homeric antiquities and mythology. The work of the second term is directed towards a thorough acquaintance with the idiom and vocabulary of Attic prose, as a preparation for rapid reading. The Oeconomicus and Symposium of Xenophon and the Crito of Plato are read during the term, with sight readings from the Memorabilia and the Apology; accompanied by discussions of domestic life at Athens. The work of the year includes a thorough review-drill on the principles of Greek accidence and syntax, and exercises in Greek prose composition are required, based, during the second term, on the reading done by the class. Greek history is studied throughout the year, with special reference to the development of political institutions.

The Sophomore class takes up, during the first term, the study of Herodotus and Thucydides. Selections are made from both authors with the purpose of illustrating their best style and at the same time of presenting, from the original sources, the history of certain interesting epochs; the reading from Herodotus, after some drill on the Ionic forms, being in large part at sight. During the second term, the class reads one or two plays of Euripides, with attention to the history of Greek tragedy, the life of the author and the analysis of the drama read. The lyric meters are studied, with the aim of gaining a knowledge of the rhythmical and metrical principles of Greek poetry. During this term an elective course is offered, the subject being Greek oratory, with the reading of certain orations of Lysias or Demosthenes or both.

The Junior year is devoted to a further study of the drama, selected plays of Sophocles, Aristophanes and Æschylus being read during the year. Work is also done in the study of public and private antiquities, partly in lectures by the professor and partly in original investigation on allotted subjects by the students.

During the first term of Senior year, Greek Philosophy is studied with the use of a text-book and with readings from Plato. The second term is in part devoted to the reading of selected odes of Pindar, with careful study of the history of Greek Lyric poetry and of the life and work of Pindar in particular. The course concludes with a review of the history of Greek literature, intended to summarize and harmonize the fragmentary views of the general subject gained from the study of particular authors and departments of literature.

LATIN.—Much of the training in the Freshman year is devoted to laying a good foundation in Latin Grammar and in the translation of English into Latin. The authors studied are used to illustrate both of these, and a large amount is read at sight in order to cultivate quickness and readiness in the student. Roman History is begun, accompanied with full comments and lectures upon points of interest. Collateral reading will also be recommended each year throughout the course. Cicero: De Senectute and De Amicitia or the Philippics, Livy and the Odes and Epodes of Horace are read this year. With the last named, training is given in Latin meters.

During this and the following year, courses of lectures will be given upon Roman Antiquities in addition to a text-book. The topography of Rome with its remains, ancient life in its various aspects, and the other departments of archaeology will be discussed, illustrated by the new and extensive set of magic lantern slides, which have been prepared for this purpose.

The Sophomore year completes the text-book on Roman History. Prose composition is continued, and the subject of Synonyms taken up in connection with it. The Satires

and Epistles of Horace are read in the first term, and in the second the Agricola and Germania, with selections from the Annals of Tacitus, or Quintilian (Bk. X), together with sight reading. An elective in Plautus is offered during this term in addition.

In the Junior year, Selected Letters of Cicero and Pliny are read, followed by Persius and several plays of Terence. The History of Roman Literature is entered upon in the second term.

The work in the Senior year opens with Lucretius, accompanied with lectures on Roman Philosophy. One of Cicero's philosophical treatises, such as the De Officiis, De Finibus, or De Natura Deorum, is taken up in the second term. After the completion of the Roman Literature, lectures will be given upon the History of the Latin Language and upon the Principles of Comparative Philology.

SANSKRIT.—An elementary course in this study, conducted by the Professor of Latin, is offered as an optional during the Senior year.

ENGLISH.—During Freshman and Sophomore years, careful training is given in the writing of essays and in declamation. This is followed, during Junior and Senior years, by exercises in Oratory, with further training in essay writing. Excellence in Oratory is encouraged by the annual contest for the Alumni Prizes, held on the 22d of February and open to the Junior class in all departments.

The second term of Sophomore year takes up the study of Rhetoric, which is pursued with the aid of a text-book and thorough practical exercises.

The History of English Literature and the philological history of the English language are studied during Junior year. These are supplemented by a series of lectures, extending through the first term, on the relations of Literature to History.

The course is completed by a series of lectures on English and American Literature, delivered during the second term of Senior year.

MODERN LANGUAGES.—The study of modern languages is obligatory from the first term of the Sophomore year up to the close of the course. The student elects either French or German, or both, if time permits.

French.—The grammar is begun, reading being introduced immediately. The comparative and historical relations of the French to the English, and the connection of both with the Latin are carefully explained. As soon as possible the student is emancipated from the reader and takes up, in a progressive way, the reading of different authors; preference being given to modern writers, because it is considered to be of the highest importance that he acquire the language as it is, as an instrument whereby further knowledge can be obtained.

In the class-room, the language taught is used by the teacher as much as possible, in order that the ear of the pupil may become accustomed to its sound. Dictation is also employed, in order to give training in spelling. The rules of grammar are taught by numerous written exercises. In the second term of the Junior year, compositions in French are required, upon subjects which have been previously explained in French, in order that the student may become acquainted with different expressions and forms of construction. Before entering upon the study of an author's works, his life and literary achievements are discussed in French, which is translated, if necessary. In the Senior year, twelve lectures are delivered upon the History of French Literature. In addition to this, lectures in French upon the most distinguished modern authors are given to advanced students.

A weekly conversation-class affords opportunity for this kind of practice; and in it the events of the day and various historical and literary topics are discussed. Private courses of reading are also suggested to those who desire it.

German.—The German course follows the same plan as that laid down for the French, both as regards the methods employed and the opportunities afforded. The relations of

English and German are dwelt upon and also those which connect the two languages with the Indo-European family.

MATHEMATICS.—The mathematical work is carried on during the Freshman and Sophomore years as follows:

Freshman year, first term, Chauvenet's Geometry, four exercises per week.

Second term, Olney's University Algebra, Plane and Spherical Trigonometry, including Mensuration and use of Logarithmic Tables, together five exercises per week throughout the term.

Sophomore year, first term, Olney's General Geometry and Davies's Analytical Geometry, four exercises per week.

Second term, Olney's Differential and Integral Calculus, four exercises per week. This term's work is elective for the Classical Course.

ASTRONOMY.—This study is taken up during the first term of the Senior year, Young's General Astronomy being used as the text-book. There are three exercises a week, and visits to the Observatory help to make the work interesting as well as profitable.

CHEMISTRY.—This study includes a complete course of lectures in Freshman year upon General Inorganic Chemistry, in which the principles of the science are fully covered. These are illustrated by experiments, and are sufficiently extended to enable a student who desires to pursue the subject further to take Analytical Chemistry as an elective in the second term of the Sophomore year. The text-book used in connection with the lectures is Fownes' Elementary Chemistry.

PHYSICS.—This important subject is presented in a course of lectures during the first term of the Sophomore year, three times a week. These are illustrated by means of the very complete apparatus of the Physical Laboratory. In the course in Science and Letters, the work in this branch is more extended and is identical with that given to the Civil and Mechanical Engineers. It occupies five hours a week in the first term, when Mechanics, Heat and Elec-

tricity are discussed. Throughout the second term, three hours a week are devoted to Sound, Light and Meteorology.

GEOLOGY.—In the second term of the Senior year, a course of lectures is given in connection with Geikie's text-book. The general principles of the science are explained, and the theories of the formation and stratification of rocks, the successive periods of the development of the earth's crust, the extinct forms of life and similar questions are treated.

PHYSIOLOGY AND HYGIENE.—These subjects are taught in a course of lectures during the Freshman year.

HISTORY, POLITICAL SCIENCE AND LAW.—The study of History begins with a course in the Political Antiquities of Greece and Rome. [See the Departments of Greek and Latin.] This is followed by the study of an outline of Universal History (with text-book), in which it is sought to give a clear view of the relations of ancient and modern states to the world's history. The same aim is then pursued in a fuller study of the Political History of Recent Times, and especially of that of England and France. During the first term of Senior year, there is a course of lectures upon the period covered by Gibbon's Decline and Fall of the Roman Empire, intended to emphasize and strengthen the impression of the interdependence of the nations and of the unity of history. This prepares the way for a course of lectures on the Philosophy of History, in which it is sought to show the relations of the sciences of Biology, Anthropology, Ethnology, Geography and Philology to the study of History and to set forth the scientific methods of that study.

The course in History is accompanied and supplemented by courses of lectures on Constitutional Law with special application to the Constitution of the United States; and also on International Law.

Instruction is given by lectures on the elements of Political Economy. The student is made familiar with the facts, methods and doctrines of the science, and is encouraged to form and present his own opinions.

LOGIC.—In this subject there is an elementary course, occupying two hours a week during the first term of Junior year. The work is done with the aid of a text-book, attention being centered on the principles of correct definition and valid proof.

MORAL PHILOSOPHY.—The course in Moral Philosophy comprises recitations from the text-book, with discussion of ethical theories; followed by studies in the history of morals, using Lecky's History of European Morals from Augustus to Charlemagne. In connection with this course, a full course of lectures is delivered upon the nature and authority of the Christian Evidences.

PSYCHOLOGY.—The course will comprise recitations from the text-book, with general discussion of the most important topics under this subject.

HISTORY OF PHILOSOPHY.—The study of this subject is confined to Senior year. In the study of the History of Greek Philosophy [see Department of Greek], the principal emphasis is laid upon Plato and Aristotle and upon the post-Aristotelian schools. During the second term the course will embrace an historical and critical study of Ancient and Modern Philosophy.

THE COURSE IN SCIENCE AND LETTERS

substitutes the following for the Latin and Greek.

DRAWING.—In the first term of the Freshman year the student is instructed in Elementary Projections, Shading and Lettering.

ZOOLOGY AND BIOLOGY.—The study of these subjects covers one year, beginning with the second term of Sophomore year. The work begins with a description of the various animal functions, and is extended to the comparative anatomy and physiology of the organs in typical species. Systematic Zoology is then completed and followed by the theories of Biology.

CHEMISTRY. — In addition to the Course in General Chemistry described above, three exercises a week in Qualitative Analysis are taken in the second term of the Freshman year.

MINERALOGY.—Instruction in Mineralogy is given to the students in the Course in Science and Letters throughout the Junior year. In the first term, they attend a course of lectures on Crystallography, followed by a series of practical exercises in the determination of crystalline forms by the aid of models and natural crystals.

In the second term a course on the physical properties of minerals and on descriptive mineralogy, with the use of E. S. Dana's Text Book of Mineralogy, is followed by practical exercises in the determination of minerals.

GEOLOGY.—The study of Lithology is pursued in the first term of the Senior year, with laboratory practice, Williams' Lithology being used as the text-book. During the next term, the course given above is taken with the Classical and Latin-Scientific students.

THE CLASSICAL COURSE.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry (Chauvenet). (4)
Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)
Greek.—Homer: Odyssey. Prosody. (3)
Latin.—Cicero: de Senectute and de Amicitia. Livy begun. Prose Composition. (2)
History.—History of Greece. (1)
Physiology and Health.—Lectures. (1)
English.—Exercises and Declamations. (1)
Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Pt. III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Greek.—Xenophon: Oeconomicus. (3)

Latin.—Livy completed. Horace: Odes and Epodes. Composition and Prosody. (4)

History.—History of Greece. (2) History of Rome. (1) Roman Antiquities.

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry. Olney's General Geometry. (4)

Physics.—Lectures. (3)

French.—Whitney's Practical French Grammar. Keetel's Analytical Reader. (2) Or *German.*—Brandt's Grammar. Lodeman's Manual of Exercises. Joynes' Otto's Reader. (2)

Greek.—Herodotus and Thucydides. (2)

Latin.—Horace: Satires and Epistles. Composition. (2)

History.—History of Rome. (2) Antiquities.

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

French.—Grammar and Reader (continued). (2) Or *German.*—Grammar, Exercises and Reader (continued). (2)

English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)

History.—Weber's Outlines of Universal History. (2)

Greek.—Euripides: Medea. (3)

Latin.—Tacitus: Agricola, Germania and Annals, or Quintilian: Book X. Composition. (3) Antiquities.

Essays and Declamations. (1)

Gymnasium. (2)

In addition to the above exercises, four hours per week must be selected from the following elective studies:

Mathematics. — Differential and Integral Calculus: Olney. (4)

Greek.—Demosthenes: De Corona. (2)

Latin.—Plautus. (2)

French.—Grammar and Reader. (2)

German.—Grammar and Reader. (2)

Chemistry.—Qualitative Analysis—Laboratory. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Wilhelm Müller's Political History of Recent Times, and Lectures. (2)

Philosophy.—Coppée's Logic. (2)

English.—Coppée's English Literature. (4)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Greek.—Sophocles: Electra. Antiquities. (3)

Latin.—Letters of Cicero and Pliny. (3)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)

Philosophy.—Hill's Psychology. (2) Political Economy. (1)

English.—Earle's Philology of the English Tongue. (2)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Gasc's Translator. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Greek.—Aristophanes: Clouds. Æschylus: Prometheus. (3)

Latin.—Persius and Terence. Cruttwell's History of Roman Literature. (3)

Essays and Original Orations. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History.—Decline and Fall of the Roman Empire: Gibbon. (3)

Philosophy.—Haven's Moral Philosophy. (2)

Astronomy.—Loomis' Treatise, with Lectures. (3)

French.—Grammar. Saintsbury: Specimens of French Literature. Readings in Corneille, Racine, Molière, etc., and contemporary authors. Compositions. Lectures on French Literature. (2) Or *German.*—Grammar. Readings in Lessing, Herder, Goethe, Schiller, etc., and contemporary authors. Compositions. Lectures on German Literature. (2)

Conversation Class in both languages optional throughout the year.

Greek.—Plato: Phædrus. Greek Philosophy. (2)

Latin.—Lucretius, with Lectures. Roman Literature. (2)

Essays and Original Orations. (1)

Gymnasium. (2)

SECOND TERM.

Constitutional Law.—Lectures. (1)

History.—History of France. (2)

Philosophy.—History of Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences. (1)

French.—Readings. Compositions. Lectures in French on modern French authors. (2) Or *German.*—Readings. Compositions. Lectures in German on modern German authors. (2)

Geology.—Lectures. Geikie. (2)

Greek.—Pindar: Selected Odes. Greek Literature. (2)

Latin.—Cicero: de Officiis, with Lectures. (2)

Lectures on American and English Literature. (2)

Preparation of Thesis.

Gymnasium.

THE LATIN-SCIENTIFIC COURSE.

The Latin-Scientific Course, leading to the degree of Bachelor of Science (B.S.), is based on Latin without Greek.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry (Chauvenet completed). (4)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

German.—Joynes-Meissner's Grammar. Joynes-Otto's Reader. (3)

Latin.—Cicero: De Senectute and De Amicitia. Livy begun. Prose Composition. (2)

History.—History of Greece. (1)

Physiology and Health.—Lectures. (1)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of the Logarithmic Tables. (2)

German.—Grammar. Reader (continued). (3)

History.—History of Greece. (2) History of Rome. (1) Roman Antiquities.

Latin.—Livy (completed). Horace: Odes and Epodes. Composition and Prosody. (4)

English.—Exercises and Declamations. (1)

Gymnasium. (2.)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4.)

Physics.—Lectures. (3)

French.—Whitney's Practical French Grammar. Keetel's Analytical Reader. (2)

German.—Grammar. Reading. (2)
History.—History of Rome. (2) Antiquities.
Latin.—Horace: Satires and Epistles. Composition. (2)
English.—Exercises and Declamations. (1)
Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney. (4)
English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)
French.—Grammar. Reader (continued). (2)
German.—Grammar. Reading. Dictation. (2)
History.—Weber's Outlines of Universal History. (2)
Latin.—Tacitus: Agricola, Germania and Annals, or Quintilian: Book X. Composition. (3) Antiquities.
Essays and Declamations. (1)
Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Wilhelm Müller's Political History of Recent Times, and Lectures. (2)
Philosophy.—Coppée's Logic. (2)
English.—Coppée's English Literature. (4)
French.—Grammar. Reading. (2)
German.—Readings in Lessing, Herder, Goethe, Schiller and contemporary authors. Dictation. Compositions. (2)
Conversation Class in German optional throughout the year.
Latin.—Letters of Cicero and Pliny. (3)
Literature and History. (1)
Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)
Philosophy. — Hill's Psychology. (2) Political Economy. (1)

English. — Earle's Philology of the English Tongue. (2)

French. — Grammar. O'Connor: Choix de Contes Contemporains. Gasc's Translator. Dictation. (2)

German. — Readings (continued). Dictation. Compositions. (2)

Latin. — Persius, Terence. Cruttwell's History of Roman Literature. (3)

Essays and Original Orations. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law. — Lectures: Woolsey. (2)

History. — Decline and Fall of the Roman Empire: Gibbon. (3)

Philosophy. — Haven's Moral Philosophy. (2)

Astronomy. — Loomis' Treatise, with Lectures. (3)

French. — Saintsbury: Specimens of French Literature. Readings in Corneille, Racine, Molière, etc., and contemporary authors. Lectures on French Literature. (2)

German. — Readings (continued). Compositions. Lectures on German Literature. (1)

Conversation Class in both languages optional throughout the year.

Latin. — Lucretius, with Lectures. Roman Literature. (2)

Essays and Original Orations. (1)

Gymnasium.

SECOND TERM.

Constitutional Law. — Lectures. (1)

History. — History of France. (2)

Philosophy. — History of Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences. (1)

Geology. — Lectures. Geikie. (2)

Latin. — Cicero: de Officiis, with Lectures. (2)

French.—Readings (continued). Compositions. Lectures in French on modern French authors. (2)

German.—Readings (continued). Compositions. Lectures in German on modern German authors. (1)

Lectures on American and English Literature. (2)

Preparation of Thesis.

Gymnasium.

COURSE IN SCIENCE AND LETTERS.

The Course in Science and Letters, leading to the Degree of Bachelor of Science (B.S.), is designed for those who wish to pursue both Scientific and Literary studies without Latin and Greek. These being omitted, extended instruction is given in French and German, History, General Literature, Mathematics and General Science.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry, (Chauvenet completed.) (4)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

German.—Joynes-Meissner's Grammar. Joynes-Otto's Reader. (3)

Drawing.—Elementary Projections, Shading and Lettering. (2)

History.—History of Greece. (1)

Physiology and Health.—Lectures. (1)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of the Logarithmic Tables. (2)

Chemistry.—Qualitative Analysis. (3)

History.—History of Greece. (2) History of Rome. (1)

German.—Grammar. Reader (continued). (3)
English.—Exercises and Declamations. (2)
Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)
French.—Whitney's Practical French Grammar. Keetel's Analytical Reader. (2)
German.—Grammar. Readings. (2)
History.—History of Rome. (2)
English.—Exercises and Declamation. (1)
Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney. (4)
Physics.—Sound, Light and Meteorology. Lectures. (3)
English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)
French.—Grammar. Readings (continued). (2)
German.—Grammar. Readings. Dictation. (2)
History.—Weber's Outlines of Universal History. (2)
Essays and Declamations. (1)
Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Wilhelm Müller's Political History of Recent Times, and Lectures. (2)
Philosophy.—Coppée's Logic. (2)
English.—Coppée's English Literature. (4)
French.—Grammar. Readings. (2)

German.—Readings in Lessing, Herder, Goethe, Schiller and contemporary authors. Dictation. Compositions. (2)

Conversation Class in German optional throughout the year.

Zoology.—Lectures and Laboratory work. Tenney. (2)

Crystallography.—Lectures, with practical exercises in the determination of Crystals. (2)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)

Philosophy.—Hill's Psychology. (2) Political Economy. (1)

English.—Earle's Philology of the English Tongue. (2)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Gasc's Translator. Dictation. (2)

German.—Readings (continued). Compositions. (2)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the determination of Minerals. (3)

Essays and Original Orations. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History.—Decline and Fall of the Roman Empire. (3)

Philosophy.—Haven's Moral Philosophy. (2)

Astronomy.—Loomis' Treatise, with Lectures. (3)

French.—Saintsbury: Specimens of French Literature. Readings in Corneille, Racine, Molière, etc., and contemporary authors. Compositions. Lectures on French Literature. (2)

German.—Readings (continued). Compositions. Lectures on German Literature. (1)

In both languages, Conversation Class optional throughout the year.

Geology.—Williams' Lithology and Laboratory Practice. (2)

Essays and Original Orations. (1)

Gymnasium.

SECOND TERM.

Constitutional Law.—Lectures. (1)

History.—History of France. (2)

Philosophy.—History of Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences. (1)

French.—Readings (continued). Compositions. Lectures in French on modern French authors. (2)

German.—Readings (continued). Compositions. Lectures in German on modern German authors. (1)

Geology.—Historic, Dynamic and Economic Geology. Geikie. (2)

Lectures on American and English Literature. (2)

Preparation of Thesis.

Gymnasium.

THE SCHOOL OF TECHNOLOGY.

This School includes six distinct courses:

I. The Course in Civil Engineering.
II. The Course in Mechanical Engineering.
III. The Course in Mining and Metallurgy.
IV. The Course in Electrical Engineering.
V. The Course in Chemistry.
VI. The Course in Architecture.

These have the same curriculum of studies for the first term of the Freshman year. At the end of that time the student selects his course and follows its program.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Chauvenet's Geometry (completed). (4)
Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)
French.—Chardenal, First Course. Keetel's Analytical Reader. (3) Or *German.*—Joynes-Meissner's Grammar. Joynes-Otto's Reader. (3)
Drawing.—Free Hand Sketching and Lettering. (2)
English.—Exercises and Declamations. (2)
Physiology and Health.—Lectures. (1)
Gymnasium. (2)

THE COURSE IN CIVIL ENGINEERING.

The special technical studies in this course may be grouped under the heads of Surveying, Applied Mechanics, Road and Railroad Construction, Bridge Design, and Hydraulic and Sanitary Engineering.

The work in Surveying extends over seven terms and embraces land surveying, leveling, topography, triangulation, railroad reconnaissance and location, hydrography, and the elements of geodesy. A large equipment of transits, levels and other surveying tools, affords students the opportunity of becoming familiar with the instruments of different manufacturers. Much time is devoted to practice in the field and drafting room, each student being required to become proficient in the use of instruments, in taking field notes, and in map drawing. Particular attention is paid to the execution of topographical surveys and maps by the best modern methods. During the senior year there is done secondary triangulation work of a high order of precision.

The work in Applied Mechanics comprises the strength and elasticity of materials, the theory of the equilibrium of arches, roofs and bridges, that part of the mechanics of machinery which relates to locomotives and hoisting machines, and the theory of hydraulics and hydraulic motors. Here the theoretical principles are illustrated by examples and problems taken as far as possible from actual engineering practice and a special report is required from

each student on the testing machines of the Bethlehem Iron Company.

The course in Construction familiarizes the student with the qualities of materials used in engineering structures, with methods of preservation and testing, with masonry and foundations, and with the building and maintenance of roads and railroads. Plans, drawings, and estimates of cost are prepared for the construction of a line of railroad, all details, such as drains, culverts, road crossings, etc., being worked out by each student.

The course in Bridge Design is preceded by the theory of computation of stresses by both analytical and graphic methods. Starting with the specifications for a first-class iron highway or railroad bridge, each student then makes the full computations, designs, working drawings, and bills of material for a plate girder and for a pin connected truss bridge. The weight of the designed bridge is finally determined and compared with the dead load assumed for the calculations. The drawings are made and dimensioned in the same manner as in the drafting office of a bridge company. In connection with this course, visits of inspection to bridges in the vicinity are regularly made.

The work in Hydraulic and Sanitary Engineering embraces the study of systems of water supply, the collection, purification and distribution of water, the combined and the separate systems of sewerage, the methods for the disposal of sewage, and the best practice for the drainage and ventilation of houses. The hydraulic laboratory in the University Park affords opportunity for experiments on the actual measurement of water by means of weirs and orifices, and the testing of hydraulic motors.

Besides these special studies there is a course in Astronomy which includes practical work in the observatory. The study of English, and of French or German, is continued, and instruction is given during four terms in Crystallography, Mineralogy, Lithology and Geology.

The student who completes all the studies of this course will receive the degree of Civil Engineer (C.E.)

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Surveying.—Theory of Chain and Compass Surveying. Computation of Areas. Elements of Leveling. (1)

French.—Chardenal, Second Course. (Reader continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Drawing.—Projection Drawing and Descriptive Geometry. Warren's Elementary Projection Drawing. (4)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat, and Electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Drawing.—Isometric Drawing. Architectural Drawing. (2)

Surveying.—Use of the Compass, Level and Transit. Surveys and Maps of Farms. Colored Topography. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Surveying.—Profiles and Contour Maps. Hydrographic and City Surveying. Use of the Plane Table. Topographical Drawing. (3)

Essays and Declamations.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus, and Wood's Analytical Mechanics. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation Class in both languages optional throughout the year.

Surveying.—Triangulation. Leveling. Topographical Surveying with Transit and Stadia. Topographical Map. (4)

Strength of Materials.—Elasticity and Strength of Wood, Stone, and Metals. Theory of Columns, Shafts and Beams. Reports on the Testing of Materials. (4)

Construction.—Materials of Construction. Masonry. Foundations. Construction of Roads and Pavements. (2)

Crystallography.—Lectures, with practical exercises in the determination of Crystals. (2)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German*—Readings. Compositions. Lectures on German Literature. (2)

Surveying.—Theory of Railroad Curves. Railroad Reconnaissance and Location. Survey of a Line, with Profile, Map and Estimate of cost. (4)

Roofs and Bridges.—Theory and Calculation of Strains in Roof and Bridge Trusses. Graphical Statics. (3)

Construction.—Stone cutting, with practical Drawings. (2) Construction and Maintenance of Railroads. Theory of Retaining Walls and Stone Arches. (2)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the Determination of Minerals. (3)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Astronomy.—Loomis' Treatise, with Lectures. (3)

Bridges.—Suspension, Continuous and Cantilever Bridges. Design of Plate Girders and Riveted Bridges, with Working Drawings. (6)

Surveying.—Use of Solar Transit and Sextant. Precise Triangulation. Elements of Geodesy. The Figure of the Earth. (3)

Mechanics of Machinery.—Pile Drivers, Cranes, and Elevators. The mechanics of the Locomotive. (2)

Geology.—Williams' Lithology, with practical exercises in determining rocks. (2)

Gymnasium.

SECOND TERM.

Astronomy.—Doolittle's Practical Astronomy, with Observatory Work. (2)

Bridges.—Design of Pin Connected Bridges, with Working Drawings. (3)

Hydraulics.—Hydrostatics. Efflux of water from orifices, and flow in pipes and rivers. Hydraulic motors. (2)

Hydraulic and Sanitary Engineering.—Collection, Purification and Distribution of Water. Systems of Water Supply. The Combined and the Separate System of Sewerage. Disposal of Sewage. House Drainage. Hydraulic Experiments. (4)

Geology.—Historic and dynamic. Geikie. (2)
Lectures on English Literature. (2)
Christian Evidences.—Lectures. (1)
Preparation of Thesis.
Gymnasium.

THE COURSE IN MECHANICAL ENGINEERING.

The object of this course is the study of the Science of Machines; the principal subjects taught are: the nature, equivalence and analysis of mechanisms, the mechanics or theory of the principal classes or types of machinery, Mechanical Technology and the principles and practice of Machine Design.

That the students may obtain the practical engineering data which they will most need when beginning their work as mechanical engineers, they are required to pursue a course of Shop Instruction which does not necessarily involve manual labor and manipulation of tools, but is principally devoted to familiarizing them with those points in pattern-making, moulding, forging, fitting and finishing, which they need to know as designers of machinery. Particular attention is therefore directed to the forms and sizes of machine parts that can be readily constructed in the various workshops, to the time that it takes to perform, and the order of, the various operations, to the dimensions most needed by workmen and to the various devices for increasing the accuracy of the work, durability of the parts and convenience of manipulation. This involves acquaintance with the processes and machinery of the workshops, but it is the foreman's and superintendent's knowledge which is required rather than the manual dexterity and skill of the workman and tool hand. The acquirements peculiar to the latter are by no means despised, and students are encouraged to familiarize themselves therewith during leisure hours, but manual work in the shops forms no regular part of the course. On the contrary, the student enters the shop

with hands and mind free to examine all the processes, operations and machinery, and is ready at the call of the teacher to witness any operation of special interest. Provided with note-book, pencil, calipers and measuring rule, the student sketches the important parts of the various machine-tools, notes down the successive steps of each of the important shop-processes as illustrated by the pieces operated upon, and follows pieces of work through the shops from the pig or merchant form to the finished machine.

That the students may learn to observe carefully and be trained to think and observe for themselves in these matters, there is required of them a full description of the various processes, operations and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings and finished pieces which are not being constructed in the shops at the time and the blue prints for which have been given to them on entering the shops. The student's work is directed not only by these drawings and by the printed program given him at the start, but also personally by a teacher, who accompanies him into the shops, gives necessary explanations, and tests the extent and accuracy of his knowledge by examining the sketches and notes and by frequent questioning. Finally the results of the observations and the sketches are embodied in a memoir.

During the course there are frequent visits of inspection to the Bethlehem Iron Co., the L. V. R. R. Shops at Easton, and other engineering works both in and out of town, with special reference to such subjects as Machine Elements, Prime Movers, Machinery for lifting, handling and transporting, and Machinery for changing the form and size of materials. It is intended that each of these excursions shall have some definite purpose in view which must be fully reported by the students. These visits are also made the occasion for constant practice in the Free Hand Sketching of Machinery.

The instruction in Machine Design begins with second term of the Freshman year and is continued throughout

the course. At first tracings of good examples of machine drawings are made; then there is considerable drill in the interpretation of such drawings and general views of lathes, planers, drills and shapers are made from the drawings of the details. This is followed by difficult projections and intersections and exercises in the empirical proportioning of machine parts. Both empirical and rational formulas are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice and the drawings made full size. During the Junior year the class takes up the design of a high speed steam engine, every dimension being determined by the students and complete drawings made. During the Senior year the students undertake the calculations, estimates and working drawings involved in the design of a simple but complete machine, each student being engaged upon a different machine. From the finished drawings of each machine, tracings are made and then blue prints taken for distribution among the other members of the class. In the case of the machines and of the engine, the general plan or arrangement will be given to the students in the form of rough sketches, photographs or wood-cuts. In the last term the students are expected to make original designs for simple machinery, whose object has been fully explained. Throughout the course the work in the draughting room is carried on as nearly as possible like that of an engineering establishment, and special attention is paid to methods of expediting the work of calculation by means of simple formulas, tables and diagrams.

The graduate in this course will receive the degree of Mechanical Engineer (M.E.).

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

French.—Chardenal, Second Course. Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Drawing and Machine Design.—Tracings. Interpretation of machine drawings by isometric sketches. General views from given details. Sections of stub ends and valve passages. Intersection of boiler flues. Empirical proportioning of machine parts. (5)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

Machine Design.—Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods. (2)

Visits of Inspection.—Examination and sketching of principal machine parts in the shops of the vicinity. (2)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney and Courtenay. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.* — Grammar. Reading. Dictation. (2)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Steam Engine.—Holmes's Steam Engine. (3)

Essays and Declamations. (1)

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus and Wood's Analytical Mechanics. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation Class in both languages optional throughout the year.

Mechanical Technology.—Shop instruction. Examination of the processes and appliances involved in pattern making, moulding, forging, fitting and finishing, with sketches and reports. (7)

Boilers.—Wilson. Strength, construction and wear and tear of boilers. (1)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, shafts and columns. Reports on experimental tests. (4)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.* — Readings. Compositions. Lectures on German Literature. (2)

Kinematics of Machinery. Reuleaux. Nature and Equivalence of Mechanisms. (3)

Machine Design.—Calculations and Working Drawings for a High Speed Steam Engine. (5)

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

Machinery of Transmission.—Weisbach-Herrmann. (2)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Thermodynamics.—General principles; application to Steam Engines and Air Compressors. (3)

Graphical Statics.—Graphical Analysis of Roof Trusses and Girders. (2)

Machine Design.—Calculations and working drawings for hoisting, pumping and metal-working machinery. (4)

Kinematics.—Diagrams of the changes of position, speed and acceleration in mechanisms. Link and valve motions. Quick return motions. Parallel motions. Laying out of Cams. (3)

Mechanics of Machinery.—Weisbach-Herrmann. Hoisting machinery, accumulators, cranes and locomotives. (4)

Gymnasium.

SECOND TERM.

Mechanics of Machinery.—Weisbach-Herrmann. Pumps, pumping engines, blowing engines, compressors and fans. (4)

Machine Design.—Original Designs. (5)

Hydraulics.—Hydrostatics. Flow of water in pipes and channels; hydraulic motors. (2)

Measurement of Power.—Indicating of Steam Engines; determination of evaporative efficiency of boilers; dynamometer experiments. (1)

Lectures on American and English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

THE COURSES IN MINING AND METALLURGY.

These courses aim to fit the student for practical work in either of the branches of mining, metallurgy, metallurgical chemistry, or geology. On account of the great number and scope of the studies necessary to the attainment of the degree of Engineer of Mines (E.M.), which includes that of Metallurgist, five years are required. At the end of the fourth year, the student will have completed a course similar to that leading to the scientific degree in other institutions, and will receive the degree of Bachelor of Science (B.S). At the end of the freshman year an opportunity is given the student to select one of two courses leading to the above degrees. These allow a full course in either mining or metallurgy to be acquired in four years, and afford to the student whose time is limited and who desires to practice one of the above branches, the means for rapid work. The graduate in either course can obtain the engineer's degree (E.M.) by one year of post-graduate work. The following program of subjects and studies shows the requirements for the degree of Engineer of Mines.

Modern Languages.—Although the option of studying French or German lies with the student, it may be well to note that the current literature of the subjects taught in these courses is more abundant in the latter language.

Drawing and Construction.—The course in machine design begins in the second term of Freshman year with tracings of good examples of machine drawings; then follow the interpretation of such drawings, and the making of general views of machines from detailed sketches; exercises in projection drawing from the same, and the proportioning of simple tools and machines. In Sophomore year the metallurgist becomes acquainted with the arrangement and details of metallurgical plant and in Senior year he designs the same. The post-graduate, during the entire year, becomes acquainted with and designs mining plant. The field work in mining and geological surveying is followed by map construction from field notes. Practice in

mining and metallurgical construction is also afforded by the projects.

CHEMISTRY. — The course in theoretical and applied chemistry extends over three years and includes work in wet and dry assaying of all the important ores and metallurgical products met with in actual practice, combined with the working of stoichiometric problems and the study of chemical philosophy. The practical work is that required for a metallurgical chemist or assayer.

With moderate care the expenses in this department need not exceed $120.

MINERALOGY. — This subject is divided into two courses. In the first course, after a short exposition of the laws of crystallography and a description of crystalline forms, practical exercises are held in the determination of simple and complex crystals, in which the student is taught to identify the various crystalline forms observed in minerals by the aid of models and of actual crystals, and with the use of the application goniometer. The second course includes the subjects of physical, descriptive and determinative mineralogy. As in the first course, the greater part of the time is devoted to practical exercises which, in this course, have for their object the determination of minerals. Each student is thus enabled to become familiar with the more common minerals by the actual handling of several hundred specimens, with the facility of making such tests as will not injure them. The presence of one or more instructors during each exercise permits the student to make frequent reports of his determinations, and to receive much instruction as to the characteristics of the minerals. The knowledge thus acquired can be supplemented by visits to the museum.

The courses in blowpipe analysis may be considered as auxiliary to the practical exercises in determinative mineralogy. In the latter the student is urged to rely chiefly on physical tests; in the former he is required to determine minerals by the aid of the blowpipe.

The mineralogical laboratory offers facilities for an advanced course in crystallography and in physical and microscopic mineralogy to a few students who may receive permission to pursue such a course.

GEOLOGY.—This subject is studied with special reference to the needs of the mining engineer. Within a radius of twenty miles the student meets and becomes acquainted with the rocks of the archæan, the palæozoic and mesozoic formations, and makes geological maps from his own field notes, paying attention to the lithological characters of the formations, as they are mainly non-fossiliferous. An extended practical course in lithology familiarizes the student with the rocks of importance to the mining engineer and enables him to determine them by sight. There are over 2000 specimens in the collection, embracing all the known species. The course in historic geology is illustrated by a cabinet of typical specimens. The course in economic geology supplements the above work by familiarizing the student with the geological horizon of all the valuable constituents of the earth's crust and the theories of their formation.

ASTRONOMY.—After studying the theory of the subject, two thirds of the year are devoted to practical work in the observatory.

APPLIED MECHANICS.—This embraces hydraulics, a study of the steam engine and the mechanics of machines employed in mining and metallurgy.

SURVEYING.—A course extending over five terms offers practice in land, mine and geological surveying, leveling, topography, triangulation, and railroad reconnaissance and location. It also includes practical work in drawing and map construction.

METALLURGY.—There are two courses of, together, about one hundred and forty lectures upon this subject, which extend throughout a year. In these the chief object kept in view is a clear presentation of the principles involved in

the various metallurgical processes, looked upon as the application to practice of the laws of chemistry, physics and mechanics. This is followed, in the case of each process, by a description of the more important examples of the plant and of the methods of conducting the process, and by indications concerning its economic features. In order to ensure that the student shall understand the fundamental principles of metallurgy, and shall become so familiar with them as to be able readily to apply them, he is required to solve a series of problems in which these principles are involved. Many of the problems are such as are likely to present themselves to the metallurgist in his current practice.

The metallurgical laboratory affords opportunity for special investigations in subjects connected with metallurgy to such advanced students as are competent to conduct them.

MINING.—This subject is covered by three courses. The first begins with the application of economic geology to the needs of the engineer, so that he can study and value mining properties, locate appropriately the necessary plant, and calculate the cost of production. It includes the discussion of faults and the means of finding faulted bodies, with practical problems. The subjects of blasting, timbering and winning deposits are applied to actual cases, as tunnel driving, etc., and problems from practical data are solved by the students. The second course covers the subjects of underground and surface haulage ; loading, unloading and stocking ores ; pumping ; ventilation ; hygiene and mining law. A series of problems are given in each of these subjects to cover cases that meet the engineer in ordinary practice. The third course treats of the mechanical preparation of ores by the wet, dry, or magnetic methods, and especially of the preparation of anthracite coal.

The location of the university in the vicinity of the iron works of the Lehigh Valley and especially of the extensive establishment of the Bethlehem Iron Company, affords unusual facilities for the practical study of iron metallurgy. The processes for the manufacture of spelter and oxide of

zinc may be studied at the Bethlehem Zinc Works. The facilities for the practical study of mining and economic geology are not excelled by those of any other Institution in the country. The zinc mines at Friedensville, the paint ores of the Marcellus formation, and the brown hematite and slate deposits of the Lehigh Valley are in the immediate vicinity, while within easy reach by rail are the semi-bituminous and anthracite coal fields, the block and fossil iron ores of the Clinton measures, the iron mines at Cornwall, Pennsylvania, and the iron and zinc mines of New Jersey; together affording examples of nearly all the methods of winning and dressing valuable deposits. Numerous visits of inspection are made in connection with the work of the course, to familiarize the student with metallurgical and mining processes and afford data for practical examples and projects.

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Pt. III. (3) Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2)

French.—Chardenal, Second Course. Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Machine and Mining Drawing.—Tracings. Interpretation of machine drawings by isometric sketches. General views from given details. Sections of stub ends and valve passages. Intersection of boiler flues. Empirical proportioning of machine parts. Graphical problems illustrating the direction and extent of throw in faults. (5)

Surveying.—Theory of chain and compass surveying. Computation of areas. Elements of leveling. (1)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

THE COURSE IN METALLURGY.

This course is arranged so that the subjects which prepare the student for practice in the field of metallurgy shall be completed at the end of four years, when the graduate will receive the degree of Bachelor of Science in Metallurgy (B.S). By remaining a year longer, and taking the subjects laid down for the post-graduate year, the graduate in this course may obtain the degree of Engineer of Mines (E.M.).

SOPHOMORE CLASS.

FIRST TERM.

Mathematics. — Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, heat and electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Drawing.—General views of metallurgical plant and detailed sketches. (2)

Surveying.—Use of the Level and Transit. Surveys and maps of farms. Colored topography. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Chemistry. - Lectures and laboratory practice. Douglass and Prescott's Qualitative Analysis. (4)

Stoichiometry. (2)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.* - Grammar. Reading. Dictation. (2)

Essays and Declamations.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics. — Courtenay's Calculus and Wood's Analytical Mechanics. (2)

Strength of Materials. — Elasticity and strength of wood, stone and metals. Theory of beams, columns and shafts. (4)

Crystallography. — Lectures, with practical exercises in the determination of crystals. (2)

Assaying. — Including the assay by the dry methods of Gold, Silver, Antimony, Mercury, Lead, Iron and Tin ores. Laboratory Work. Ricketts. (3)

Chemical Philosophy. — Cooke. (3)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation class in both languages optional throughout the year.

Literature and History.

Gymnasium. (2)

SECOND TERM.

Metallurgy.—Metallurgical Processes. Furnaces. Refractory building materials. Combustion. Natural and artificial fuels. Metallurgy of Iron. (4)

Mineralogy. — Descriptive mineralogy, with practical exercises in the determination of minerals: E. S. Dana. (3)

Blow-Pipe Analysis.— Lectures, with practice. Plattner, Brush, or Nason and Chandler. (1)

Chemistry.—Fresenius' Quantitative Analysis. (4) The following analyses are executed by the student:

1. Iron Wire (Fe)
2. Copper Ore (Cu)
3. Silver Coin (Au, Ag, Pb, Cu)
4. Zinc Ore (Zn) By both Gravimetric and Volumetric Methods.
5. Bronze (Cu, Sn, Zn, Pb)
6. Spiegeleisen (Mn)
7. Lead Ore (PbS)

8. Ilmenite (TiO_2)
9. Iron Ore (Complete Analysis)
10. Limestone (Complete Analysis)
11. Coal (Volatile Matter, Fixed Carbon, Ash, H_2O, S, P)

Steam Engine.—Holmes's Steam Engine. (3)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.*—Readings. Compositions. Lectures on German Literature. (2)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Metallurgy.—Of Copper, Lead, Silver, Gold, Platinum, Mercury, Tin, Zinc, Nickel, Cobalt, Arsenic, Antimony and Bismuth. (5)

Blow-pipe Analysis.—Practice. (1)

Lithology.—Williams' Lithology, with practical exercises in determining rocks. (3)

Mechanics of Machinery.—Weisbach-Herrmann. Hoisting machinery, accumulators, cranes. (2)

Chemistry.—Quantitative Analysis: Laboratory Work: Fresenius. (3) The following analyses are executed by the student:

12. Slag (Complete Analysis)
13. Pig Iron (Complete Analysis)
14. Carbon in Steel (Volumetric)
15. Nickel Ore (Ni, Co)
16. Gas Analysis.

Graphical Statics.—Graphical analysis of roof trusses and girders. (2)

Projects.—In metallurgy. (1)

Gymnasium.

SECOND TERM.

Mining.—Mechanical Preparation of Ores. Coal Washing. Callon. Lectures. (2)

Geology.—Economic geology. Lectures. Williams. (2)

Drawing. — Designing of furnaces and other metallurgical plant. (2)

Mechanics of Machinery. — Pumps, pumping-engines, blowing-engines, compressors and fans. (4)

Hydraulics. — Hydrostatics. Flow of water in pipes and channels. Hydraulic motors. (2)

Lectures on American and English Literature. (2)

Christian Evidences. — Lectures. (1)

Preparation of Thesis.

Gymnasium.

POST-GRADUATE YEAR.

FIRST TERM.

Mining. — Modes of occurrence of the useful minerals. Searching for mineral deposits. Examination of mining properties. Boring. Mining tools, machines and processes. Timbering and masonry. Methods of working. Callon. André. Lectures. (3)

Geology. — General geological definitions and principles. Dynamic geology. Dana. (2)

Drawing. — General views of mining plant and detailed sketches. (2)

Projects. — In geology and mining. (1)

Surveying. — Mine survey. Theory and practice, with construction of mine maps. Tunneling and shaft location. (2)

Astronomy. — Descriptive astronomy: Loomis. (3)

Surveying. — Triangulation. Leveling. Topographical surveys with transit and stadia. Topographical maps. (4)

SECOND TERM.

Mining. — Underground transportation. Hoisting, drainage and pumping. Ventilation and lighting. Hygiene of mines. Mining law. (3)

Geology. — Historic geology. Dana. (2)

Surveying. — Geological survey: Mapping and cross-sectioning. (2)

Drawing.—Designing of mining plant. (2)

Surveying.—Theory of railroad curves. Railroad reconnaissance and location. Survey of a line, with profile, map and estimate of cost. (4)

Astronomy.—Doolittle's Practical Astronomy, with observatory work. (2)

Preparation of Thesis.

THE COURSE IN MINING.

This course is designed so that the student who desires to pursue the practice of mining and ore-dressing, and who does not wish to take the full course, may be prepared for practice in four years, receiving the degree of Bachelor of Science in Mining (B.S.). By remaining a year longer, and taking the subjects laid down for the post-graduate year, the graduate in this course may obtain the degree of Engineer of Mines (E.M.).

This course is identical with the preceding up to the end of the Freshman year.

SOPHOMORE CLASS.

FIRST TERM.

Mathematics. — Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, heat and electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Crystallography.—Lectures, with practical exercises in the determination of crystals. (2)

Surveying.—Use of the level and transit. Surveys and maps of farms. Colored topography. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Chemistry.—Lectures and laboratory practice. Douglass and Prescott's Qualitative Analysis. (4)

Mineralogy.—Descriptive mineralogy, with practical exercises in the determination of minerals: E. S. Dana. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Essays and Declamations.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus and Wood's Analytical Mechanics. (2)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, columns and shafts. (4)

Geology.—General geological definitions and principles. Dynamic geology. Dana. (2)

Lithology.—Williams' lithology, with practical exercises in determining rocks. (3)

Surveying.—Triangulation. Leveling. Topographical surveys with transit and stadia. Topographical maps. (4)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation class in both languages optional throughout the year.

Literature and History.

Gymnasium. (2)

SECOND TERM.

Geology. — Historic and Economic Geology. Lectures. Dana. (4)

Blow-Pipe Analysis.—Lectures, with practice. Plattner, Brush, or Nason and Chandler. (1)

Surveying.—Geological survey: Mapping and cross-sectioning. (2)

Steam Engine.—Holmes's Steam Engine. (3)

Surveying.—Theory of railroad curves. Railroad reconnaissance and location. Survey of a line, with profile, map and estimate of cost. (4)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.* — Readings. Compositions. Lectures on German Literature. (2)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Mining.—Modes of occurrence of the useful minerals. Searching for mineral deposits. Examination of mining properties. Boring. Mining tools, machines and processes. Timbering and masonry. Methods of working. Callon. André. Lectures. (3)

Mechanics of Machinery.—Weisbach-Herrmann. Hoisting machinery, accumulators, cranes. (2)

Astronomy.—Descriptive astronomy: Loomis. (3)

Surveying.—Mine survey. Theory and practice, with construction of mine maps. Tunneling and shaft location. (2)

Assaying. — Including the assay by the dry methods of Gold, Silver, Antimony, Mercury, Lead, Iron and Tin ores. Laboratory Work. Ricketts. (3)

Drawing.—General views of mining plant and detailed sketches. (2)

Projects.—In Geology and Mining. (1)

Gymnasium.

SECOND TERM.

Mining.—Underground transportation. Hoisting, drainage and pumping. Ventilation and lighting. Hygiene of mines. Mining law. (3) Mechanical preparation of ores. Coal washing. (2)

Drawing. — Designing of mining plant. (2)

Mechanics of Machinery. — Pumps, pumping-engines, blowing-engines, compressors and fans. (4)

Hydraulics.—Hydrostatics. Flow of water in pipes and channels. Hydraulic motors. (2)

Lectures on American and English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

POST-GRADUATE YEAR.

FIRST TERM.

Metallurgy. – Of Copper, Lead, Silver, Gold, Platinum, Mercury, Zinc, etc. (5)

Blowpipe Analysis.—Practice. (1)

Chemistry. — Qualitative Analysis: Laboratory Work: Fresenius. (3) The following analyses are executed by the student:

1. Iron Wire (Fe)
2. Copper Ore (Cu)
3. Silver Coin (Au, Ag, Pb, Cu)
4. Zinc Ore (Zn). By both Volumetric and Gravimetric methods.
5. Bronze (Cu, Sn, Zn, Pb)
6. Spiegeleisen (Mn)
7. Lead Ore (PbS)

Chemical Philosophy.—Cooke. (3)

Drawing. — General views of metallurgical plant and detailed sketches. (2)

Graphical Statics.—Graphical analysis of roof-trusses and girders. (2)

SECOND TERM.

Metallurgy. — Metallurgical Processes. Furnaces. Refractory building materials. Combustion. Natural and artificial fuels. Metallurgy of Iron. (4)

Chemistry.—Fresenius' Quantitative Analysis. (4) The following analyses are executed by the student:

8. Ilmenite (TiO_2)
9. Iron Ore (complete analysis)
10. Limestone (complete analysis)
11. Coal (Volatile Matter, Fixed Carbon, Ash, H_2O, S, P)
12. Slag (Complete Analysis)
13. Pig Iron (Complete Analysis)
14. Carbon in Steel (Volumetric)
15. Nickel Ore (Ni, Co)
16. Gas Analysis.

Stoichiometry. (2)

Drawing.—Designing of furnaces and other metallurgical plant. (2)

Projects.—In Metallurgy. (1)

Astronomy.—Doolittle's Practical Astronomy, with observatory work. (2)

Preparation of Thesis.

THE COURSE IN PHYSICS AND ELECTRICAL ENGINEERING.

In the arrangement of the details of this new course, the object has been to provide for those, who seek to fit themselves as Electrical Engineers, a preliminary training as complete and broad as that given to the members of the other schools. The requirements for admission, the mathematical and English studies, the modern languages and other outside branches are the same as those in the other technical courses. To these have been added such portions of the Mechanical Engineering Course, with which this course is most closely allied, as are necessary to give

the student a general, but sufficiently accurate knowledge of machinery.

This preparation joined to the unusually full development of Physics—and especially of Electricity—will, it is thought, make a course sufficiently comprehensive and thorough for the proper training of candidates for this degree. The great success attending the large majority of the young men who have taken the one year's Course in Electricity, in their subsequent electrical work, warrants the belief that this broader and more extended course will attain its object.

The main feature of this new course is the prominence given to the subject of Physics. This extends through three years and while Electricity is specially developed, the other branches, Elementary Mechanics, Heat and Light are fully provided for. The opportunity is thus given to any one, who wishes to acquire a more extensive knowledge of Physics than the University curriculum has heretofore offered. The student is well drilled in the theory by means of lectures and recitations, which carefully cover the whole subject, and he is required to go over the ground himself in the best of all schools—the working laboratory. Enough of work on each topic is given him to render him familiar with his subject. Much prominence is given to work that brings out the resources of the student himself, such as the construction of instruments and original investigation. He is encouraged to this and a regular portion of his time is set apart for this object.

It will be seen from the preceding statement that this course offers two great advantages: the thorough and extensive training of those intending to take part in the great development of Electric Science in the industrial field now going on and the facilities offered to those who wish to take a four years' course specially devoted to the whole branch of Physics.

The degree of Electrical Engineer (E.E.) will be given to the graduates of this course.

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Chemistry.—Lectures and Laboratory Practice. Douglass and Prescott's Qualitative Analysis. (2)

French.—Chardenal, Second Course. Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Drawing.—Projection Drawing and Descriptive Geometry. Warren's Elementary Projection Drawing. (3)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics. — Analytical Geometry: Olney's General Geometry. (4)

Mechanics, Sound and Heat.—(Theory, lectures and recitations.) (3)

Mechanics.—(Physical Laboratory). Exact Measurements. Density. Elasticity. Tenacity. Hydrostatics. Specific Gravity. Atmospheric Pressure (with barometric leveling.) Gravitation. Moments of Inertia.

Sound.—Determination of velocities and wave lengths. Measurements of vibrations. Verifications of laws of vibrations of sounding bodies.

Heat.—Construction of Instruments. Thermometry. Expansion. Conduction. Radiation. (4)

Drawing.—Isometrical Drawing. Architectural Drawing. (2)

French.—Grammar. Reading. Or *German.*—Grammar. Reading. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Heat.—Continued. (Physical Laboratory.) Fusion and Vaporization. Calorimetry. Hygrometry. Elementary Thermodynamics. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar Reading. Dictation. (2)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Steam Engine.—Holmes's Steam Engine. (3)

Essays and Declamations.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus and Wood's Analytical Mechanics. (2)

French.—Readings Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation Class in both languages optional throughout the year.

Light and Magnetism.—(Theory; text-books and lectures.) (3)

Light.—(Physical Laboratory). Investigation of general Principles and Laws. Determination of Focal Lengths and Indices of Refraction. Testing and Adjustment of Optical Instruments. Spectroscopic Analysis. Photometry. Polarization. Diffraction.

Magnetism.—Fundamental Experiments. Verification of Laws of Magnets. Study and Mapping of Lines of Force. Determination of Moments of Magnets; and of horizontal component and whole intensity of Earth's Magnetism in absolute units. Distribution of Magnetism. (3)

Meteorology.—Text-book and practice. Observations for several months as taken in the U. S. Signal Service stations, with all the usual corrections and reductions; construction of charts; mapping curves; reports, etc. (1)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, columns and shafts. (4)

Boilers.—Wilson. Strength, construction and wear and tear of boilers. (1)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

Electricity.—Theory; text-books and lectures. (3)

Static Electricity.—(Physical Laboratory). Investigation of Principles. Quantitative Laws. Measurements of Potential, Capacity, etc. Induction. Condensation. Analysis of Machines.

Voltaic Electricity.—Management and care of a large variety of batteries. Construction of Instruments. Determination of Constants. Electro-Magnetism. Induction. Electro-Dynamics. Electrical Measurements of Potential, Resistance and Current Strength. Electrolysis. Electroplating. Electrotyping. Thermo-Electricity. Secondary Batteries. Relation of Electrical Currents to Heat and Mechanical Work. (5)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.* — Readings. Compositions. Lectures on German Literature. (2)

Machine Design.—Calculations for a High Speed Steam Engine. Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods. (5)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Dynamic Machines.—Theory, text-book and lectures. (2) (Physical Laboratory). Practical running and care of dynamos and motors. Measurements of magnetic field, potential, resistance and heating. Visits to manufactories and working systems. (2)

Electric Lighting.—Lectures. (2) (Physical Laboratory). Study of different systems. Calculations and arrangement of plant. Wiring. Insulation. Photometric tests of different arc and incandescent lamps. Determination of heat units given off by various incandescent lamps; their resistance (hot and cold). Energy consumed in lamps and conductors. Spectroscopic tests of purity of carbons. (3)

Machine Design.—Proportioning of Machine Parts (continued). (2)

Astronomy.—Loomis' Treatise, with Lectures. (3)

Graphical Statics of Mechanism.—Herrmann-Smith. (2)

Scientific Readings.

Gymnasium.

SECOND TERM.

Telegraphs and Telephone.—Investigation of different systems. Arrangement of lines and stations. Test of lines for conductivity, insulation, location of faults, etc. (2)

Application of Electricity to Railways.—Theory of the two systems, with inspection of electric railways. (1)

Measurement of Power.—Indicating of Steam Engines; dynamometer experiments. (1)

Dynamic Machines.—(Physical Laboratory). Tests of Efficiency in Generators and Motors, etc. (1)

Physics.—Original Investigation. (5)

English Literature.—Lectures on English and American Literature. (2)

Christian Evidences. (1)

Preparation of Thesis.—(With laboratory work).

Gymnasium.

THE COURSE IN CHEMISTRY.

This course of study is designed to prepare students for the profession of the Chemist, in connection with metallurgical establishments, sugar refineries, gas works, superphosphate works, electrical machinery manufactories, mining companies, etc., and the general consulting and analytical work of the Professional Chemist. It is also well adapted for the preparation of teachers of chemistry and as a preliminary course to the study of medicine. It is eminently practical, the student's time being largely occupied by practical work in the large, well equipped and well ventilated chemical laboratories, which were completed in 1885 and constitute the best constructed building for this purpose in this country. The museum of Chemistry contains large collections of specimens, for illustrating the lectures on theoretical and applied Chemistry.

THEORETICAL CHEMISTRY.—Instruction in this subject begins with lectures four times a week, in the first term of the Freshman year; these lectures are fully illustrated by experiments, colored diagrams, working drawings and lantern pictures and specimens from the museum. They include a general introduction to Theoretical Chemistry and a description of the non-metallic and metallic elements and their compounds, the general subject of inorganic chemistry. The students are required to take notes of the lectures, and to pass a written examination at the end of the term.

In the second term of this year Stoichiometry and chemical problems and reactions are taught by recitations twice each week.

The study of Theoretical Chemistry is continued throughout the Sophomore year, by recitations three times a week from Cooke's Chemical Philosophy and is concluded in the first term of Junior, by a course of lectures and recitations on Theoretical Organic Chemistry, four times a week. These lectures are illustrated by experiments and by specimens from the museum of Chemistry.

Written examinations are held at the close of each of the above courses.

ANALYTICAL CHEMISTRY. — Qualitative Analysis is taught in the second term of the Freshman year, by lectures, recitations and practical work in the Qualitative Laboratory, twelve hours of practical work per week being required. This laboratory is a large, well ventilated and well lighted room, and supplied with convenient working tables, vacuum filtration, hoods for noxious vapors, steam baths, gas and washing appliances and a commodious room for hydrosulphuric acid. Distilled water is delivered by faucet in this room and the other large laboratories. At the close of the term a practical examination is held in this subject.

After completing this course, Quantitative Analysis is pursued throughout the Sophomore and the first term or the Junior years. This subject is taught by lectures, recitations and practical work in the Quantitative Laboratory, which is equipped similarly to the Qualitative Laboratory, but is supplied in addition with apparatus for drying precipitates and residues, rooms for the chemical balances, for combustions, and for a reference library.

Twelve hours per week are required during the first term of the Sophomore year and fifteen hours during the second term of that year and the first term of the Junior year.

The course consists in Gravimetric and Volumetric Analyses, as applied to the substances given in the lists farther on, accuracy being required in the determination of each constituent.

At the close of each term, written examinations are held upon the theory and practice of Quantitative Analysis.

GAS ANALYSIS is taught by lectures and laboratory practice in the Gas Laboratory. This laboratory is supplied with full and complete apparatus for Gas Analysis, according to Bunsen's processes, as well as apparatus for some of the more rapid methods. Mixtures of gases are required to be analyzed by the students, within certain limits of error,

and a written examination, on the theory and practice, is held at the close of the course.

ASSAYING.—The Assaying of ores by furnace assay, together with gold and silver bullion analysis, by processes practiced in the United States Mint, is taught by lectures and practical work in the first term of the Junior year, nine hours of practical work per week being required. The course includes the assaying of ores of lead, tin, antimony, gold, silver and iron, coal, and gold and silver bullion.

The Assaying Laboratory is supplied with large working tables, twenty-nine crucible and two iron furnaces, and eight muffle furnaces, with adjoining rooms for balances, and gold and silver bullion analysis.

A certain accuracy of results and a written examination as regards the theory and practice are required.

ORGANIC CHEMISTRY.—The practical work in this subject is performed in the second term of the Junior and first term of the Senior years, fifteen hours during the former and twelve hours during the latter term being required, with conferences and recitations each week. The laboratory for this work is equipped similarly to the Quantitative Laboratory, in addition being supplied with steam heat, cold water and air blast upon the working tables, and a full supply of apparatus for the various determinations and experiments, including combustion furnaces, furnaces for heating sealed tubes, mercury pump, Hoffman's, Dumas' and Meyers' apparatus for vapor densities, nitrometers, chemical balances, etc.

The course consists of determinations of specific gravities, melting points, boiling points, vapor densities, chlorine, bromine, iodine and sulphur of organic substances.

Combustion analysis, nitrogen determination, fractional distillation, and the preparation of several pure organic compounds and their analysis are included.

INDUSTRIAL CHEMISTRY. — A course of lectures is delivered upon this subject in the second term of the Senior year, illustrated by experiments, diagrams, lantern pictures

and specimens from the museum of Chemistry. The working laboratory for this subject contains an apparatus for making illuminating gas, an alcohol still, worm and doubler and a complete working model of a sugar refinery, including filters, vacuum pan and centrifugal. In connection with this laboratory is a room containing a photometer and apparatus for determining the sulphur, ammonia and specific gravity of illuminating gas; also a laboratory for the testing of alcoholic liquors, sugar, molasses, bone black, soap, petroleum, paints, dyes, superphosphates and other commercial products, with the necessary technical apparatus. The students make practical experiments in this direction, and, with an instructor, visit various industrial establishments in this neighborhood and in and around New York City.

Toxicology.— A course of lectures on this subject is given in the first term of the Junior year, illustrated by experiments and by the large collection of specimens of poisons from the museum of chemistry. This is supplemented by a short course of laboratory work on some of the common poisons.

Sanitary Chemistry. — During the second term of the Senior year, attention is given to the qualitative and quantitative examination of air, water, food, disinfectants, and other subjects connected with this branch of the science. Special apparatus is provided for this work, as recommended by the best authorities on the subject.

Photographic Chemistry. — Well equipped Photographic Laboratory and dark rooms are provided, in which the students of the chemical course receive practical instruction.

Physiological Chemistry. — The examination of urine, blood, etc., receives a proper amount of attention.

The course also includes instruction in physics, mineralogy, blowpipe analysis, metallurgy and geology, which are of great value to the chemist.

In the last term of the Senior year, the student is required to prepare a Thesis on some subject, selected by the Professor of Chemistry, involving practical work in the laboratory in addition to the literary labor, each graduate thus making a contribution to the progress of the science, as a preliminary to the reception of his degree.

The graduate of this course receives the degree of Analytical Chemist. (A.C.)

Students, not candidates for a degree, are admitted for special courses in chemistry, of which they receive certificates.

The Laboratories are under the immediate charge of the Professor and Instructors of Chemistry and are open to the students from 8 o'clock, A.M., to 6 o'clock, P. M., including Saturdays. Students are at liberty to work in the Laboratories, beyond the required hours, as their time may permit. Students are charged for materials and apparatus consumed; with moderate care this expense need not exceed $50 per year.

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Chemistry.—Lectures and Laboratory Practice. Douglass and Prescott's Qualitative Analysis. (4)

French.—Chardenal, Second Course. Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Stoichiometry. (2)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Chemical Philosophy.—Cooke. (3)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (4)

The following analyses are executed by the student:

1. Iron Wire (Fe)
2. Potassium Dichromate (Cr_2O_3)
3. Barium Chloride (Ba, Cl, H_2O)
4. Magnesium Sulphate (MgO, SO_3, H_2O)
5. Disodium Hydrogen Phosphate (P_2O_5)
6. Rochelle Salt (K_2O, Na_2O)
7. Volumetric Determination of Chlorine.
8. Acidimetry (HCl, H_2SO_4, HNO_3, $HC_2H_3O_2$)
9. Alkalimetry (KOH, NaOH, NH_4OH, Soda Ash, Pearl Ash)
10. Chlorimetry (Bleaching Powders)

Quantitative Analysis—Conference. (1)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2).

SECOND TERM.

Physics.—Sound, Light and Meteorology. Lectures. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (5)

The following analyses are executed by the student:

11. Copper Ore (Cu)
12. Zinc Ore (Zn). By both Gravimetric and Volumetric Methods.
13. Lead Ore (Pb, S)
14. Silver Coin (Au, Pb, Ag, Cu)

15. Spiegeleisen (Mn)
16. Copper Alloys. (Complete Analysis.)
17. Ilmenite (TiO_2)
18. Iron Ore (Complete Analysis)
19. Limestone (Complete Analysis)
20. Coal (Volatile Matter, Fixed Carbon, Ash, H_2O, S, P)
21. Slag (Complete Analysis)

Quantitative Analysis.—Conference. (1)

Blow-Pipe Analysis.—Lectures, with Practice. Plattner, Brush, or Nason and Chandler. (1)

Chemical Philosophy. (3)

Essays and Declamations. (1)

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Toxicology.—Lectures. (2)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (5)

The following analyses are executed by the student:

22. Guano (NH_3, P_2O_5, H_2O)
23. Clay (Complete Analysis)
24. Manganese Ore (MnO_2)
25. Mineral Water (Complete Analysis)
26. Pig Iron (Complete Analysis)
27. Nickel Ore (Ni, Co)
28. Carbon in Steel (Volumetric)
29. Gas Analysis.

Quantitative Analysis.—Conference. (1)

Organic Chemistry.—Lectures and Recitations. (4)

Crystallography. — Lectures, with practical exercises in the determination of crystals. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation Class in both languages optional throughout the year.

Gymnasium. (2)

SECOND TERM.

Organic Chemistry.—Laboratory. (5)

Organic Chemistry.—Conference. (1)

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.*—Readings. Compositions. Lectures on German Literature. (2)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the determination of minerals. E. S. Dana. (3)

Essays and Original Orations. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Metallurgy.—Of Copper, Lead, Silver, Gold, Platinum, Mercury, Tin, Zinc, Nickel, Cobalt, Arsenic, Antimony and Bismuth. (5)

Assaying.—Including the Assay by the dry methods of Gold, Silver, Antimony, Lead, Iron and Tin ores, Coal, Gold and Silver Bullion and rich Lead. Ricketts. (3)

Organic Chemistry.—Laboratory. (4)

Organic Chemistry.—Conference. (1)

Geology.—Williams' Lithology, with practical exercises in determining rocks. (3)

Gymnasium.

SECOND TERM.

Industrial Chemistry.—Lectures and Laboratory. (4)

Agricultural Chemistry.—Lectures. (1)

Sanitary Chemistry.—Laboratory. (1)

Geology.—Historic and Dynamic Geology. Lectures. Geikie. (2)

Christian Evidences.—Lectures. (1)

Lectures on American and English Literature. (2)

Preparation of Thesis. (5)

Gymnasium.

THE COURSE IN ARCHITECTURE.

The studies in this course are closely allied with those in civil engineering, the higher surveying, railroad work, mineralogy, geology and astronomy being omitted, instead of which architectural drawing and designing is substituted as seen in the following program. Instruction is also given in the history and æsthetics of architecture, in methods of heating and ventilating, in boilers and hoisting machinery, and in house drainage and sewerage.

During the first and second years the student lays the foundation for his professional work by the study of Mathematics, Physics, Mechanics, Drawing, Surveying, English, and French or German. The course in drawing includes the use of water colors, freehand, projection and isometric drawing, and their application to the general plans for a small building. In surveying there is field practice in the use of instruments, and also map drawing, thus enabling the student to understand the application of the subject to landscape gardening, and to the location of buildings.

During the third and fourth years of the course the work is of a more professional character. The subject of construction familiarizes the student with brick, stone, cement and other materials, with foundations and masonry, with arches, piers and walls, and with the stone cutter's art. There is a full course in the theory and calculation of columns, beams and shafts, in the strength of materials and its application to roof trusses and bridges. Working drawings of arches, piers and roof trusses are made in detail. Plans and estimates are prepared for wooden, brick, stone and iron buildings, the work being done according to standard specifications. In connection with the course visits of inspection are made to the numerous engineering structures in the Lehigh Valley and vicinity.

The student who completes all the subjects of this course will receive the degree of Bachelor of Science in Architecture (B. S.).

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Surveying.—Theory of Chain and Compass Surveying. Computation of Areas. Elements of Leveling. (1)

French.—Chardenal, Second Course. (Reader continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Drawing.—Projection Drawing and Descriptive Geometry. Drawings and Sketches from measurements of Objects. (4)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat, and Electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Drawing.—Isometric Drawing and Sketching. Architectural Drawing. Plans for a simple cottage. (2)

Surveying.—Use of the Compass, Level and Transit. Surveys and Maps of Farms. Colored Topography. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

French. — Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Mechanics. — Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Surveying.—Profiles and Contour Maps. Hydrographic and City Surveying. Use of the Plane Table. Topographical Drawing and Sketching. (3)

Essays and Declamations.

Gymnasium.

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus, and Wood's Analytical Mechanics. (2)

French. — Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation Class in both languages optional throughout the year.

Strength of Materials. — Elasticity and Strength of Wood, Stone, and Metals. Theory of Columns, Shafts and Beams. Reports on the Testing of Materials. (4)

Construction. — Materials of Construction. Masonry. Foundations. Construction of Roads and Pavements. (2)

Drawing.—Shades, Shadows and Linear Perspective. Sketches and Designs for Ornaments and Simple Details. (6)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.* — Readings. Compositions. Lectures on German Literature. (2)

Roofs and Bridges.—Theory and Calculation of Strains in Roof and Bridge Trusses. Graphical Statics. (3)

Construction.—Stone cutting, with practical Drawings. (2)

Theory of Retaining Walls and Stone Arches. Designs for Piers and Stone Arches. (2)

Architecture.—Designs and Estimates for Brick and Stone Buildings. (5)

History.—The History of Architecture. (2)

Essays and Original Orations.

Gymnasium. (2)

SENIOR YEAR.

FIRST TERM.

Roofs and Bridges.—Cantilever, Suspension and Arch Bridges. Designs for Plate Girders and Riveted Roof Trusses. (6)

Mechanics of Machinery.—Pile Drivers, Cranes and Elevators. (2)

Boilers.—Strength, construction, and wear and tear of boilers. Wilson. (1)

Architecture.—Specifications and Estimates. Design for an Iron Building. (5)

Heating and Ventilation.—Systems of heating, lighting and ventilating buildings. (2)

Gymnasium.

SECOND TERM.

Hydraulics.—Efflux of Water from orifices, and flow in pipes and channels. Hydraulic Motors. (2)

Sanitary Engineering.—Collection, Purification and Distribution of Water. Systems of Water Supply. The combined and the separate System of Sewerage. Drainage and Sewerage of Buildings. (4)

Roofs and Bridges.—Design for a Pin-connected Roof Truss, with Working Drawings. (3)

Architecture.—Building Superintendence. The Æsthetics of Architecture. Original Plans, Estimates and Specifications. (4)

Lectures on English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

PHYSICAL CULTURE.

The Gymnasium is open morning, afternoon and evening, in all, 45 hours a week. Exercise in it is required of all students who are fitted to take it. Class drill with the Instructor and individual exercise are prescribed.

GRADUATING THESES.

Every student will be required to present a thesis upon some topic connected with his special course, as a necessary portion of the exercises for his final examination for a diploma. These theses shall be accompanied by drawings and diagrams, when the subjects need such illustration. The originals will be kept by the University, as a part of the student's record, for future reference; but a copy may be retained by the student, and be published, permission being first obtained from the President.

DIPLOMAS AND CERTIFICATES.

The Diploma is given only to those who have passed all the examinations in a regular course and is signed by the President and Secretary of the Board of Trustees and by the Faculty of the University. For all the partial courses a certificate is given, signed by the President and the Secretary of the Faculty, and showing what the student has accomplished.

GRADUATE STUDENTS.

Graduate students wishing to remain a year or more and pursue a course of study as candidates for another Degree may do so with the sanction of the Faculty. Those wishing to take *special* courses of study will be afforded every facility for so doing.

POST GRADUATE DEGREES.

M. A.

The Faculty will recommend for the Degree of Master of Arts any Candidate, otherwise properly qualified, who, after taking at this University the Degree of Bachelor of Arts, shall pursue, for at least one year at this University, or two years elsewhere, a course of liberal study prescribed by the Faculty in at least two departments, pass a thorough examination in the same and present a satisfactory Thesis.

M. S.

The Faculty will recommend for the Degree of Master of Science any Candidate, otherwise properly qualified, who, after taking at this University the Degree of Bachelor of Science, or any Degree in the School of Technology, shall pursue, for at least one year at this University, or two years elsewhere, a course of study prescribed by the Faculty in at least two departments, pass a thorough examination in the same and present a satisfactory Thesis.

Ph. D.

The Faculty will recommend for the Degree of Doctor of Philosophy any Candidate, otherwise properly qualified, who, after taking at this University the Degree of Master of Arts or Master of Science, shall pursue, for at least one year at this University, or two years elsewhere, a course of advanced study prescribed by the Faculty, in at least two departments, pass a thorough examination in the presence of the Faculty in the same and present a satisfactory Thesis giving evidence of original investigation.

The Candidate shall have a good knowledge of Latin and either French or German.

The Theses presented by Candidates for Post Graduate Degrees shall be retained by the University.

Applicants for any of these degrees will be required to complete the prescribed work within the allotted time. Special action of the Faculty is required for any extension of time.

THE UNIVERSITY LIBRARY.

The Library building was erected by the Founder of the University in 1877, at a cost of One Hundred Thousand Dollars, as a memorial of his daughter, Mrs. Lucy Packer Linderman, and during the same year more than Twenty Thousand Dollars were contributed by her family and friends, as a memorial fund for the purchase of books. By the will of the Founder of the University a fund of $500,000 has been given for the permanent endowment of the library.

The building is semi-circular in plan, with a handsome façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior, the center is occupied as a reading space, fifty by forty feet, from which radiate the book cases, extending from floor to ceiling; two galleries affording access to the upper cases. Shelf room is now provided for one hundred and sixty thousand volumes. The building is thoroughly fireproof, well lighted, and heated by steam.

Seventy-nine thousand volumes are now upon the shelves, including many extremely valuable works. The list of periodicals numbers about one hundred and twenty-five, embracing as far as possible all departments of knowledge.

The Library is conducted strictly for consultation, and is open to the use of the public; both of which conditions are in accord with the terms of the gift.

REGULATIONS OF THE LEHIGH UNIVERSITY LIBRARY.

I. The Library is open every day, except Sundays and Legal Holidays, from 8 A. M. until 10 P. M., and on Sundays for the students and others connected with the University from 1.30 P. M. until 9.30 P. M.

II. Admission is free to all persons over 16 years of age.

III. Readers are required to write their names and addresses in the Daily Register of the Library. They also write the name of the book desired upon a Library Card, with their signatures, and present the same to the Director's Clerk, who supplies the

book, retaining the card as a receipt. Before leaving the Library, readers return their books to the clerk, and receive their cards.

IV. The University Professors and Instructors, only, are allowed to take books from the Library Building.

V. No person is allowed to enter the alcoves, or remove any book from the shelves, without permission of the Director.

VI. Readers wishing to consult the more valuable illustrated works make special application for that purpose.

VII. In taking notes, pencils, and not pens and ink, are to be used.

VIII. Audible conversation and the use of tobacco are strictly forbidden in any part of the Library.

IX. Any person not conforming to these Regulations, will be denied the privilege of the Library.

X. Any person, who defaces, in any way, any book, magazine or paper, or the furniture, or any portion of the building, in addition to being deprived of the privileges of the Library, will be prosecuted according to law.

OBSERVATORY.

By the liberality of Robert H. Sayre, Esq., one of the Trustees of the University, an Astronomical Observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

In the dome of the Observatory is mounted an Equatorial Telescope, of six inches aperture, by Alvin Clark & Sons. The west wing contains a superior Sidereal Clock, by Wm. Bond & Sons; a Zenith Telescope, by Blunt, and a Field Transit, by Stackpole. There is also a Prismatic Sextant, by Pistor & Martins.

Students in Practical Astronomy receive instruction in the use of the instruments and in actual observation.

The grounds upon which the Observatory stands, consisting of seven acres of land adjoining the original grant, was

presented to the University by Charles Brodhead, Esq., of Bethlehem.

An advanced course in Astronomy and the higher Analysis has been established, requiring two years for its completion. It is adapted to the attainments of the graduates of this University, but is open to any one who may be prepared to pursue it.

This course embraces the following subjects:

First Year.—Spherical Astronomy. Theory of Instruments. Method of Least Squares. Numerical Calculus.

Second Year. – Celestial Mechanics. Interpolation and Quadrature. Computation of Orbits and Perturbations.

During the entire course the student will have ample opportunity to familiarize himself with the practical work of the Observatory and Computing Room.

THE PACKER MEMORIAL CHURCH,

is the recent and munificent gift of Mrs. Mary Packer Cummings, daughter of the Founder of the University. It is a large and magnificent Church, richly furnished and handsomely appointed in every particular. There is no more beautiful Church edifice in the State and it is one of the noblest in all the land.

THE UNIVERSITY MUSEUM.

In addition to the large collection illustrating all branches of Industrial Chemistry, the Museum includes collections in Metallurgy, Geology, Zoology, and Archæology.

The Metallurgical Cabinet already includes specimens illustrating the various processes for obtaining the more common metals.

The Zoological Cabinet includes the Werner collection of nearly all the types of American birds with their nests and eggs, and the Packer collection of recent shells.

The Geological Cabinet numbers over ten thousand specimens and includes the Palæontological, Mineralogical, Petrographic and Economic collections. The former contains good specimens of nearly all the common genera. The

Mineralogical division includes the Keim and Rœpper collections—the latter being especially complete and valuable from a crystallographic stand-point. The Petrographic division numbers several thousand specimens and besides including numerous varieties of nearly all the rocks of the globe, contains a duplicate set from the collection of the Second Geological Survey of this State. The Economic division was formed and donated by Dr. James P. Kimball, Director of the Mint, and formerly Professor of Economic Geology.

The Cummings Archæological Cabinet numbers three thousand specimens and includes Dr. Stubbs' Collection of Indian relics, weapons, and utensils.

THE CHEMICAL AND NATURAL HISTORY SOCIETY OF THE LEHIGH UNIVERSITY.

This Society was organized in the Fall of 1871, as "The Chemical Society," but was afterwards expanded, as its present title indicates, and admits, by election, students from all departments of the University.

The collections of Botanical and Zoological Specimens belonging to the Society are already important. During the past years persons have been sent to Texas and Brazil to collect specimens for these cabinets.

The Society has organized and maintained several courses of public scientific lectures.

Among the honorary members of the Society are more than one hundred of the most distinguished scientists in Europe and the United States.

THE ENGINEERING SOCIETY.

This society was organized in 1873, and admits, by election, students in the Junior and Senior Classes. Its meetings are held fortnightly. At these, papers relating to engineering subjects are read and discussed. It issues quarterly "The Journal of the Engineering Society," to which the members and others contribute.

THE MINING CLUB.

This was organized in 1883 and takes from the Junior, Senior and Post Senior Classes, those members of the Mining School who excel in their studies or in practical experience in the subjects of the course.

THE ELECTRICAL ENGINEERING SOCIETY

was organized in November, 1887, by students in the Advanced Course in Electricity. Its object is to supplement the regular work of the department by the study and discussion of electrical subjects.

THE AGORA

is a Literary Society which meets semi-monthly. Only students in the School of General Literature are eligible to membership.

THE ATHENÆUM.

is also a Literary Society, whose active membership is confined to the Sophomore Class. The meetings are held weekly.

THE CLASSICAL CLUB.

This organization was formed in the Spring of 1889 by students in the Classical and Latin-Scientific Courses. At its monthly meetings, papers upon philological, historical and archæological subjects are read by students belonging to the upper classes and are then discussed and criticised. Thus independent work is encouraged and correct methods of investigation are acquired. Reports upon new discoveries and reviews of recent books vary the proceedings and keep the members informed in regard to the advances of philological science.

THE UNIVERSITY GUILD

is a Society for the promotion of the religious, mental, moral and social life of the students of the University. The Right Reverend, the Assistant Bishop of Central Pennsylvania, is Honorary President and the Chaplain of the University, Honorary Vice-President. Its meetings are held fortnightly at the residence of the Chaplain. It is an active and flourishing society of important and growing influence.

THE NATURAL SCIENCE CLUB OF THE LEHIGH UNIVERSITY.

The object of this organization is systematic study, in connection with field work, in Natural History and its associated subjects. Its members are engaged in making a survey, both botanical and mineralogical, of the region within a radius of five miles from the University and propose to collect an herbarium and mineralogical cabinet which shall contain specimens of all the plants and minerals within this district.

FOUNDER'S DAY.

On the second Thursday of October of each year, Commemorative Exercises are held in honor of the Founder of the University.

Thursday, October 10, 1889, the Eleventh Founder's Day was celebrated. An address was delivered by Professor Henry Coppée, LL.D.

WASHINGTON'S BIRTHDAY.

This day is observed as a holiday.

On Thursday, February 22, 1889, exercises were held in the Chapel, and orations were delivered by Messrs. Fisher, Foering, Miller, Neumeyer, Perkins and Prindle.

UNIVERSITY SERMON.

This sermon is preached on the Sunday before University Day.

The Rev. Eliphalet Nott Potter, D.D., LL.D., President of Hobart College, was the preacher on Sunday, June 16, 1889, in the Memorial Church.

THESES.

Theses on the following subjects were prepared by the graduating class of 1889.

"Steam Heating of Railroad Cars."

PEARCE ATKINSON.

"Determination of the Power consumed by a Drill Press."

GUSTAV AYRES.

"Description and Discussion of the Cabin John Stone Arch, near Washington, D. C."

RALPH PUTNAM BARNARD.

"A Discussion of the Porter Governor."

ALBERT HARLAN BATES.

"Menander."

SAMUEL ERWIN BERGER.

"Experiments on the Rapid Separation of Nickel and Cobalt."

JOSEPH LEANDER BUDD.

"Heinrich Heine."

EDGAR CAMPBELL.

"Investigation of the Reaction between Potassium Permanganate and Cobaltous Oxide."

FRANCIS JOSEPH CARMAN.

"Design of an American Passenger Locomotive."

HERBERT MACKENZIE CARSON.

"Review of the Canal Bridge on Main Street in Old South Bethlehem."

HOLDEN WILLIAM CHESTER.

"A Comparison of Interlocking and Railroad Signaling Appliances."

JUSTICE COX CORNELIUS.

"Examination of the 'Standard' Westinghouse Automatic Engine."

WILLIAM ALBERT CORNELIUS.

"Design for an Iron Highway Bridge between Bethlehem and South Bethlehem, Pa."

CHARLES HERBERT DEANS.

"The Code Napoleon."

CHARLES ESTELL DICKERSON, JR.

"Algebraic and Graphical Methods for Determining Moments of Inertia of Plane Figures."

EMIL DIEBITSCH.

"The Chemical Investigation of Wine."

ERNEST HIPOLITE DU VIVIER.

"The Internal Struggle in Rome between the Plebeian and Patrician Orders."

WILLIAM DOLLOWAY FARWELL.

"The History of the Chemical Theory."

MILTON HENRY FEHNEL, B.S.

"Richard Wagner."

ARTHUR HUGH FRAZIER.

"Design for a High Trestle for the Raritan Valley Railroad."

LOUIS PREVOST GASTON, B.S.

"Discussion of Experiments on the Efficiency of the Six-inch Eureka Turbine in the Hydraulic Laboratory of the Lehigh University."

LIGHTNER HENDERSON.

"Design for an Iron Highway Bridge betwen Bethlehem and South Bethlehem, Pa."

CLARENCE WALTER HUDSON.

"The Naphtha Engine."

ARCHIBALD JOHNSTON.
JOHN MARTIN SHARPLESS KERLIN.

"Review of the Process of Manufacture of Leather by means of Oak and Hemlock Barks."

JOHN STOWER KELLOGG, JR.

"Greek Tragedy."

SYLVANUS ELMER LAMBERT.

"Review of the Bridges on the Lehigh & Lackawanna Railroad between Bethlehem and Bath."

JOHN JOSEPH LINCOLN.

"Design for an Ice Machine and Refrigerator."

JOHN LOCKETT.

"Experiments on the Rapid Estimation of Magnesium as Pyrophosphate."

ARTHUR LONG.

"Design for a Wrought Iron Foot Bridge over the North Pennsylvania Railroad at New Street, South Bethlehem, Penna."

JOHN JOSEPH MARTIN.

"Comparative Delicacy of Several Tests for Iodine."

CHARLES HENRY MILLER.

"The Economic Value of Forced Draughts."

CHARLES WILLIAMS MOFFETT.

"The Archer Gas Process."

WILLIAM ELLIS MORRIS.

"Design for an Atlantic Passenger Steamer."

JOHN THOMAS MORROW.

"Deduction of a Formula for the Secular Variation of the Magnetic Declination at South Bethlehem, Pa."

ALBERT DANIEL OBERLY.

"A Comparison of Rapid Methods for determining Silicon, Iron, Manganese and Phosphorus in Ores; also, a plan for a Chemical Laboratory adapted to analytical work at an ore mine."

JOSEPH MICHAEL O'MALLEY.

"The Westinghouse Air Brake."

ROBERT HENRY EDDY PORTER.

"A Test of the Steam Plant at the Electric Light Station, Fort Wayne, Ind."

ABRAHAM LINCOLN ROGERS.

"Design for a Rotary Valve Gear."

CHARLES WILLIAM SCHWARTZ, JR.

"A Review of the Lehigh Valley Railroad from Mauch Chunk to Penn Haven.

ALFRED WALTON STOCKETT.

"Plan for a Horse Railway between Bethlehem and South Bethlehem."

LESTER CLARK TAYLOR.

"Review of the Water-Supply System at Clyde, N. Y."

AUGUSTUS THOMPSON THROOP.

"Design for a Timber-Mortising Machine."

CHARLES PRENTICE TURNER.

"The Examination of Commercial Fixed Oils and Fats."

WALTER EARLE WEIMER.

"Stresses in Bridge Trusses due to Initial Tension in Counters."

EDWARD AUSTIN WRIGHT.

"A Review of the Pratt Truss Bridge on the Pennsylvania Railroad at Phillipsburg, N. J."

JOSEPH BODINE WRIGHT.

THESES FOR THE DEGREE OF E.M.

"The Eighth Street Cable Railway Tunnel at Kansas City, Mo."

RICHARD SINGMASTER BREINIG.

"Economic Questions in Anthracite Coal Preparation."

OTTO CORNELIUS BURKHARDT.

"A Review of Archer's Patent Process for the Production of Fuel Gas."

ALFRED ELI LEWIS, JR., B.S.

"Shaft-sinking in Water-bearing Strata, with a Review of the Poetsch-Sooy-Smith System."

WYNDHAM HARVEY STOKES, B.S.

"Construction of a Blast Furnace."

WADE HAMPTON WOODS, B.S.

THESES FOR THE DEGREE OF M.A.

"The Roman Law, and its Influence on the English."

FRANCIS JOSEPH CRILLY, B.A.

"Early English Parliament."

JOHN DANIEL HOFFMAN, B.A.

UNIVERSITY DAY.

This day is the last of the academic year and falls in 1890 on the third Thursday in June. On this day orations are delivered by members of the Graduating Class, and Degrees are conferred.

EXERCISES ON JUNE 20, 1889.

Reading of Scripture and Prayer by the Rt. Rev. M. A. de Wolfe Howe, D.D., LL.D., Bishop of the Diocese.

Salutatory Oration.—"Copernicus."

SAMUEL ERWIN BERGER.

Oration.—"Immigration."

CHARLES PRENTICE TURNER.

Oration.—"Savonarola."

FREDERICK LOUIS GRAMMER.

Oration.—"The Inter-oceanic Canal."

EMIL DIEBITSCH.

Oration.—"Rienzi."

WILLIAM DOLLOWAY FARWELL.

Valedictory Oration.

JOHN LOCKETT.

Award of the Wilbur Scholarship to

WALTON FORSTALL,

of Chicago, Ill., first in rank in the Sophomore Class.

The Wilbur Prizes were awarded as follows:

Freshman Class, Mathematics,

CHARLES MERRITT CASE,

CHARLES OAKS WOODS.

Freshman Class, French.

JOHN YOUNG BASSELL, JR.

Freshman Class, German.

ALFRED EMORY LISTER.

Freshman Class, Free Hand Drawing.

ROBERT JONES SNYDER.

Prizes for Machine Drawing, offered by Mr. Flather, Instructor in Mechanical Engineering, were awarded to

ALFRED EMORY LISTER,

ROBERT JONES SNYDER,

of the Freshman Class.

The following degrees were conferred :

M. A.

FRANCIS JOSEPH CRILLY, B. A.,
JOHN DANIEL HOFFMAN, B. A.

E. M.

RICHARD SINGMASTER BREINIG,
OTTO CORNELIUS BURKHARDT,
ALFRED ELI LEWIS, JR., B. S.,
WYNDHAM HARVEY STOKES, B. S.,
WADE HAMPTON WOODS, B. S., B. M.

B. A.

SAMUEL ERWIN BERGER,
EDGAR CAMPBELL,
WILLIAM DOLLOWAY FARWELL,
ARTHUR HUGH FRAZIER,
SYLVANUS ELMER LAMBERT.

B. S.

CHARLES ESTELL DICKERSON, JR.

C. E.

RALPH PUTNAM BARNARD,
HOLDEN WILLIAM CHESTER,
JUSTICE COX CORNELIUS,
CHARLES HERBERT DEANS,
EMIL DIEBITSCH,
LOUIS PREVOST GASTON, B. S.,
LIGHTNER HENDERSON,
CLARENCE WALTER HUDSON,
JOHN JOSEPH LINCOLN,
JOHN JOSEPH MARTIN,
ALBERT DANIEL OBERLY,
ALFRED WALTON STOCKETT,

LESTER CLARK TAYLOR,
AUGUSTUS THOMPSON THROOP,
EDWARD AUSTIN WRIGHT,
JOSEPH BODINE WRIGHT.

M. E.

PEARCE ATKINSON,
GUSTAV AYRES,
ALBERT HARLAN BATES,
HERBERT MACKENZIE CARSON,
WILLIAM ALBERT CORNELIUS,
ARCHIBALD JOHNSTON,
JOHN MARTIN SHARPLESS KERLIN,
JOHN LOCKETT,

CHARLES WILLIAMS MOFFET,
JOHN THOMAS MORROW,
ROBERT HENRY EDDY PORTER,
ABRAHAM LINCOLM ROGERS,
CHARLES WILLIAM SCHWARTZ, JR.,
CHARLES PRENTICE TURNER.

B. S.

(In Mining and Metallurgy.)

JAMES WILLOUGHBY ANDERSON,
RICHARD SINGMASTER BREINIG,
OTTO CORNELIUS BURKHARDT,
CHARLES WILLIAM CORBIN,
JOHN WEBSTER DOUGHERTY,
RALPH MARSHALL DRAVO,
FREDERICK LOUIS GRAMMER,
GEORGE WENTZ HARRIS,
CONRAD EGBERT HESSE,
RICHARD HENRY MORRIS, JR.,
ARNOLD KARTHAUS REESE,
ARTHUR MOULT SMYTH,
CLARENCE WALKER,
HARRY RUSH WOODALL.

A. C.

JOSEPH LEANDER BUDD,
FRANCIS JOSEPH CARMAN,
ERNEST HIPOLITE DU VIVIER,
MILTON HENRY FEHNEL, B. S.,
JOHN STOWER KELLOGG, JR.,
ARTHUR LONG,
CHARLES HENRY MILLER,
WILLIAM ELLIS MORRIS,
JOSEPH MICHAEL O'MALLEY,
WALTER EARLE WEIMER,

The Benediction was then pronounced by the Bishop.

THE WILBUR SCHOLARSHIP.

This Scholarship was founded in 1872 by E. P. Wilbur, Esq., of South Bethlehem, and is the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

THE ALUMNI SCHOLARSHIP.

The Alumni Association of the University has established a Scholarship of the value of $250 per annum, subject to the following conditions:

1. That the Scholarship shall only be awarded to a student really in need of it.

2. That the Scholarship shall not apply to the first year of any student's course; he must without this aid have gone through one year, and must be prepared to start the second year free from all conditions.

3. That the Scholarship shall not be continued to a student who shall at any time during his course carry any condition over eight weeks beyond the date of the examination in which he failed.

Subject only to the above conditions the disposal of the fund shall until otherwise directed be in the hands of the President of the University.

THE HENRY S. HAINES MEMORIAL SCHOLARSHIP.

Mrs. Henry S. Haines, of Savannah, Ga., has established a scholarship of the annual value of $200 which is to be devoted to the support at the Lehigh University, throughout his scholastic career, of one student in the School of Mechanical Engineering; the selection to be made by Mrs. Haines herself, during her life-time.

WILBUR PRIZE.

By the generosity of E. P. Wilbur, Esq., a fund has been established yielding an annual income of $100, for distribution in prizes as the Faculty shall determine.

ALUMNI PRIZES FOR ORATORY.

The "Alumni Association of the Lehigh University" has established an Annual Sum of Fifty Dollars, to be distributed as prizes for excellence in Oratory, subject to the following

REGULATIONS.

1. The Contest shall be held on the 22d day of February, or on the day designated by the University to commemorate the birthday of Washington.
2. There shall be a first prize of $25, a second of $15, and a third of $10.
3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.
4. Subjects for the oration shall be announced at the beginning of the first Term of every year, and upon one of these each competitor shall write an oration not to exceed eight minutes in delivery.
5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the

writer, with the declaration that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do —should they be sufficient in number—the best six shall be chosen, and their envelopes opened. The others shall be returned to the address given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors, whose orations shall have been approved, and the awards shall be made by a majority of these Judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

At the last contest, the First Prize was awarded to

HOWARD AUGUSTUS FOERING,

the Second, to

ROBERT ENGLER NEUMEYER,

and the Third, to

EDWIN JAY PRINDLE.

The next contest will take place February 22, 1890.

ENTRANCE EXAMINATION PAPERS.

Used at the Examination in 1889.

[Requests for other examination papers than those herein printed can not be granted.]

I.—ENGLISH GRAMMAR.

1. Give the principal parts of the verbs *shrink*, *kneel*, *let*, *beat*, *chide*, *fly*, *shake*, *thrive*, *swim*.

1. How is the plural of compound nouns formed? Give two nouns that have no plural form; two that have no singular form.

3. Name and define the different classes of adjective pronouns.

4. Write four sentences: the first is to contain *that* as an adjective; the second, *that* as a relative pronoun; the third, *that* as an adjective pronoun; the fourth, *that* as a conjunction.

5. How are the person and number of the verb determined when the subject is compound?

6. Correct or justify the following sentences:

a. Neither Anna nor Ernest have permission to go.

b. Everybody are very kind to her.

c. Let any pupil put this in diagram if they can.

d. Was it thou or the wind who shut the door?

e. All pupils which have recited may be dismissed.

f. It was me that did it.

g. I bade him to take heed lest he makes life a failure?

h. The number of bounty jumpers are enormous.

i. How is the gender and number of the relative known?

j. I can not tell who I saw there.

7. Analyze this sentence fully, naming and classifying all clauses. Name five adjective phrases found in it. Parse words in italics.

"The storm had *long* given place to a calm the most *profound*, and the evening *was* pretty far *advanced*, *when* the three friends, *or*, *as* one might say, *both* in a civil *and* religious sense, and with proper deference and regard to the holy state of matrimony, the two friends (Mr. and Mrs. Brodie *counting as* no more *than* one) were startled by the noise of loud and angry threatenings *below* stairs, *which* presently attained *so* high a pitch, and were conveyed besides by language so towering and ferocious *that* it could hardly have been surpassed, *if there* had actually been a Saracen's head then present in the establishment, supported on the shoulders and surmounting the trunk of a real, live, furious, and most unappeasable Saracen."

II.—GEOGRAPHY.

An outline map of the Eastern half of the United States was furnished to each applicant and he was required to draw the boundaries of States, place capitals and chief cities, principal rivers and mountain systems.

III.—UNITED STATES HISTORY.

1. When did New Jersey become a Royal?—when an entirely separate Colony?—and when were the first settlements made?

2. What three Acts were passed by Parliament in 1767? What was their effect on the Colonies? What was done for the next six years? Who were the Whigs, and who the Tories?

3. What powers were given to Washington by Congress before its abandoning Philadelphia? When did Washington take Trenton, and when did the battle of Princeton take place?

4. Who were about 1786 the leading men of the country? and what did they propose, in order to make a Constitution in place of the Articles of Confederation? When was this Constitution agreed to, and when had it to go into force?

5. What were the leading events of Adams's Administration? Has Adams served one or two terms?

6. What were the four parties at the Presidential election of 1860? and who were their candidates?

7. What were the positions of the Union army in the West in the beginning of 1863? What were the different plans of Gen. Grant about Vicksburg? Who commanded in Vicksburg? and when was Vicksburg taken?

8. How is the Senate composed? How are the Senators chosen, and how long do they serve? Who presides over the Senate? When does the Chief Justice preside?

9. Name at least four of the powers that are denied to the States.

10. How is a vacancy by the removal, death, resignation or inability of the Vice-President to be provided for?

IV.—ARITHMETIC.

1. (*a*) Write the numbers: ten billions and ten; one million and one millionth; eleven thousand eleven hundred and eleven.

(*b*) What is an odd number? A prime number? A factor? A dividend? A quotient?

(*c*) Give rules for position of decimal point in multiplication and division.

2. How many square inches in a square foot? How many inches in a metre? In a link? Links in a chain? Square rods in an acre?

3. Bethlehem is 1° 40′ 3″ East of Washington. What is the time at Bethlehem when it is 2 P.M. at Washington?

4. 1 mile 10 rods 3 feet 2 inches equal how many kilometres?

5. Find interest, discount, and bank discount on $1755.16 for 60 days at 5 per cent.

6. At what time between 6 and 7 o'clock will the hour and minute hand of a clock be together?

V.—GEOMETRY.

1. (*a*) Define a right line; a plane; a plane angle; a right angle.

(*b*) Define the various kinds of triangles; also quadrilaterals.

(*c*) Define a circle; a chord; a secant; a tangent; a sector: a segment.

2. (*a*) Define a diedral angle; plane angle of a diedral angle: polyedral angle: convex polyedral angle.

(*b*) Define similar polygons; regular polygons; geometrical locus. State the conditions under which a single figure is said to be symmetrical.

(*c*) Define a variable: limit of a variable. Give example of limit of a variable. Define maximum quantity; minimum quantity. Give example of a maximum quantity.

3. The three medial lines of a triangle meet in a point.

4. If the sum of two opposite sides of a quadrilateral is equal to the sum of the other two sides, the quadrilateral may be circumscribed about a circle.

5. If through any fixed point in the plane of a circle a chord is drawn, the product of the segments is the same whatever the direction of the chord (take the point outside the circle).

6. If similar polygons be constructed upon the sides of a right triangle as homologous sides, the one on the hypothenuse will be equivalent to the sum of those on the other two sides.

7. Show how to compute the ratio of the *diameter* of a circle to the *circumference* approximately.

8. Of all plane figures having the same area the circle has the minimum perimeter.

9. A common perpendicular can be drawn to any two lines not in the same plane, and but one.

10. The sum of all the face angles of any polyedral angle is less than four right angles.

VI.—ALGEBRA.

1. (*a*) Give definitions of quantity; number; commensurable quantities; theorem; axiom; postulate.

(*b*) Give definitions of involution; evolution; equation; degree of an equation.

2. (*a*) What is the greatest common divisor of two or more quantities? What is elimination? Explain the three methods of elimination.

(*b*) Explain how fractions are added and multiplied. Explain how radicals are added and multiplied.

3. Give formulæ for nth term and sum of n terms of an arithmetical progression. What is the form to which every equation of the second degree may be reduced?

4. Find the greatest common divisor of the following:

$$\left\{\begin{matrix} 4x^3 - 6x^2 - 4x + 3 \\ 2x^3 + x^2 + x - 1 \end{matrix}\right\}; \qquad \left\{\begin{matrix} 6x^2 - 30x - 36 \\ 9x^2 + 27x + 18 \\ 12x^2 - 12 \end{matrix}\right\}.$$

5. Solve the following equations:

$$(a + x)(b + x) = (m + x)(n + x);$$

$$\frac{x - 2}{5} + \frac{.301}{.5} = .001x + .6 - \frac{x - 2}{.05};$$

$$\left\{\begin{matrix} \frac{1}{x} + \frac{1}{y} = \frac{1}{a}; \\ \frac{1}{y} + \frac{1}{z} = \frac{1}{b}; \\ \frac{1}{z} + \frac{1}{x} = \frac{1}{c}. \end{matrix}\right\}$$

6. Reduce the following expressions to simplest forms having rational denominators:

$$\left(\frac{1 + x}{1 + \sqrt{1 + x}} - \frac{1 - x}{1 - \sqrt{1 + x}}\right); \quad \left(\frac{1 + \sqrt{-1}}{1 - \sqrt{-1}} - \frac{1 - \sqrt{-1}}{1 + \sqrt{-1}}\right);$$

$$\left(\frac{a + \sqrt{-b}}{a^{-\frac{3}{2}} b^{\frac{1}{2}}} \times \frac{a - \sqrt{-b}}{a^{-\frac{1}{2}} b^{\frac{1}{2}}}\right)$$

7. A sum of money at interest amounted to $550 in ten months, and to $560 in 12 months. What was the sum, and the rate per cent.?

8. Solve the following equations:

$\sqrt{x} - \sqrt{x - 3} = \frac{2}{\sqrt{x}}$; find value of x.

$\frac{1}{a + b + x} = \frac{1}{a} + \frac{1}{b} + \frac{1}{x}$; find value of x.

$\left.\begin{matrix} 2x^2 - 2xy - y^2 = 3; \\ x^2 + 3xy + y^2 = 11; \end{matrix}\right\}$ find value of x and y.

VII.—PHYSICS.

NOTE.—*The examination in Physics must be passed in June or September of that year in which the candidate proposes to enter the University.*

1. Define (*a*) Absolute Unit of Force.
   (*b*) Gravitation.
   (*c*) Difference of Potential.
   (*d*) Luminous Body.
   (*e*) Mechanical Equivalent of Heat.
2. What is Mariotte's Law?
3. How much water will flow from an orifice 2 inches in diameter in an hour, if the surface is kept 49 feet above the center of the orifice, and what will be the velocity of the water as it issues?
4. A body falls 1000 meters in vacuo.
   (*a*) What is the time of its fall?
   (*b*) What is its velocity at the end?
5. What are the Elements of a Musical Sound? Name and define them.
6. An observer supposes himself in the range of a distant cannon, the report of which he hears 19 seconds after seeing the flash; how soon may he apprehend danger from the ball, supposing it to fly at the rate of a mile in 8 seconds, the temperature of the air being 84 degrees Fahrenheit?
7. How can the Latent Heat of Water be determined experimentally?
8. Five pounds of ice at 32 degrees Fahrenheit are mixed with 7 pounds of water at 200 degrees Fahrenheit. What will be the temperature of the mixture?
9. How much ice at 32 degrees Fahrenheit is required to cool 10 pounds of mercury at 300 degrees Fahrenheit to the freezing point of water, the specific heat of mercury being 0.0333?
10. What is Double Refraction?
11. If a battery of 6 cells, each with an E.M.F. of 1.4 volts and an internal resistance of 5 ohms, be arranged with an external resistance of 80 ohms, first in parallel and secondly

in series ; what would be the strength of current in each case ?

12. Describe the Electrophorus.

13. Describe the Electric Lamps.

(*a*) Arc.

(*b*) Incandescent.

14. What must be the potential of a battery, which with a total resistance of 4.6 ohms gives a current of 0.036 amperes ?

VIII.—LATIN.

I. Grammar.

[In writing Latin words of more than two syllables, mark the quantity of the penult.]

1. Give the genitive and accusative singular of *portus*, *animus*, *pelagus ;* the genitive and dative plural of *dea*, *vis*, *caput*, *mare ;* the dative singular of *aliquis*, *cornu ;* the nominative singular of *nivem*.

2. Decline in full : *nubes*, *dies*, *idem*, *alius*, *movens*.

3. Give gender of the following words with reason for each : *nauta*, (a sailor), *morus* (a mulberry tree), *Carthago*, *carbasus*, *lac*.

4. Compare the adjectives *gracilis*, *malus*, *nequam*, *creber* and the adverb *prope*.

5. Write the ordinal numerals from one to ten inclusive ; and decline the cardinal number two.

6. Give the principal parts of the verbs from which the following forms are derived : *virite*, *cedentia*, *jussus*, *vestit*, *ruperat*.

7. Give the imperfect and perfect subjunctive active, and the present and future participles of *fero*, *capio*, *pono*.

8. Inflect the present subjunctive and present imperative of *eo ;* and the future and perfect indicative of *fio*.

9. Give the participles of the verb *loquor* and state how a deponent verb differs from a passive verb.

10. Explain the subjunctives occurring in the following sentences :

(*a*) *Facerem, si juberes.*

(*b*) *Amemus patriam.*

(*c*) *Ac fuit antea tempus, cum Germanos Galli virtute superarent.*

(*d*) *Huic mandat, Remos reliquosque Belgas adeat.*

What classes of verbs take two accusatives? What construction is used with verbs of remembering?

II. Caesar.

Translate (Bk. II., 14):—

Pro his Divitiacus—nam post discessum Belgarum, dimissis Haeduorum copiis, ad eum reverterat—facit verba: 'Bellovacos omni tempore in fide atque amicitia civitatis Haeduae fuisse: impulsos a suis principibus, qui dicerent Haeduos, ab Caesare in servitutem redactos, omnes indignitates contumeliasque perferre, et ab Haeduis defecisse, et populo Romano bellum intulisse. Qui ejus consilii principes fuissent, quod intellegerent quantam calamitatem civitati intulissent, in Britanniam profugisse.'

Where did the Bellovaci dwell? Which are the principal verbs in the speech? What is the antecedent of *Qui?*

Translate (Bk. IV., 5):—

His de rebus Caesar certior factus, et infirmitatem Gallorum veritus, quod sunt in consiliis capiendis mobiles et novis plerumque rebus student, nihil his committendum existimavit. Est enim hoc Gallicae consuetudinis, uti et viatores etiam invitos consistere cogant, et quid quisque eorum de quaque re audierit aut cognoverit quaerant; et mercatores in oppidis vulgus circumsistat, quibusque ex regionibus veniant quasque ibi res cognoverint pronuntiare cogant.

How long was Caesar in Gaul? *Cogant*, why subjunctive?

III. Cicero.

Translate (Cat. II., §13):—

Hic ego vehemens ille consul, qui verbo civis in exsilium eicio, quaesivi a Catilina in nocturno conventu ad M.

Laecam fuisset necne. Cum ille, homo audacissimus, conscientia convictus, primo reticuisset, patefeci cetera: quid ea nocte egisset, quid in proximam constituisset, quem ad modum esset ei ratio totius belli descripta, edocui.

Why is *fuisset* in the subjunctive? What is the difference between *homo* and *vir?*

Translate (*Cat. IV.*, §18) :—

Quae cum ita sint, patres conscripti, vobis populi Romani praesidia non desunt: vos ne populo Romano deesse videamini providete. Habetis consulem ex plurimis periculis et insidiis atque ex media morte, non ad vitam suam, sed ad salutem vestram reservatum. Omnes ordines ad conservandam rem publicam mente, voluntate, voce consentiunt.

(*Archias*, §26) :—

Itaque, credo, si civis Romanus Archias legibus non esset, ut ab aliquo imperatore civitate donaretur perficere non potuit. Sulla cum Hispanos donaret et Gallos, credo hunc petentem repudiasset: quem nos in contione vidimus, cum ei libellum malus poeta de populo subjecisset, quod epigramma in eum fecisset, tantummodo alternis versibus longiusculis, statim ex eis rebus quas tunc vendebat jubere ei praemium tribui, sed ea condicione, ne quid postea scriberet.

How is the word *credo* used here? Explain the formation of *libellum*.

Translate (*Manilian Law*, §47) :—

Reliquum est ut de felicitate (quam praestare de se ipso nemo potest, meminisse et commemorare de altero possumus, sicut aequum est homines de potestate deorum) timide et pauca dicamus. Ego enim sic existimo: Maximo, Marcello, Scipioni, Mario, et ceteris magnis imperatoribus non solum propter virtutem, sed etiam propter fortunam saepius imperia mandata atque exercitus esse commissos.

What idea was conveyed to the Roman by the word *felicitate?*

Give dates of the four men named.

IV. Vergil.

Translate (Aen. II., 318):—

Ecce autem telis Panthus elapsus Achivom,
Panthus Orthryades, arcis Phoebique sacerdos,
Sacra manu victosque deos parvumque nepotem
Ipse trahit, cursuque amens ad limina tendit.
'Quo res summa loco, Panthu? Quam prendimus arcem?'
Vix ea fatus eram, gemitu cum talia reddit:
Venit summa dies et ineluctabile tempus
Dardaniae: fuimus Troes, fuit Ilium et ingens
Gloria Teucrorum; ferus omnia Juppiter Argos
Transtulit; incensa Danai dominantur in urbe.

Write out the first and third lines, dividing them into feet and marking the caesuras and the ictus. Explain the form *Achivom*. Tell who Phoebus was.

Translate (Aen. VI., 124):—

Talibus orabat dictis, arasque tenebat,
Cum sic orsa loqui vates: 'Sate sanguine divom,
Tros Anchisiade, facilis descensus Averno;
Noctes atque dies patet atri janua Ditis;
Sed revocare gradum superasque evadere ad auras,
Hoc opus, hic labor est.'

How is Anchisiade declined? Who is the speaker?

V. Latin at Sight.

Caesar eo tempore cum legione una profectus ad recipiendas ulteriores civitates et rem frumentariam expediendam, qua anguste utebatur, erat ad Buthrotum, oppositum Corcyrae. Ibi certior ab Acilio et Murco per litteras factus de postulatis Libonis et Bibuli legionem relinquit; ipse Oricum revertitur. Eo cum venisset, evocantur illi ad colloquium. Prodit Libo atque excusat Bibulum, quod is iracundia summa erat inimicitiasque habebat etiam privatas cum Caesare ex aedilitate et praetura conceptas: ob eam causam colloquium vitasse, ne res maximae spei maximaeque utilitatis ejus iracundia impedirentur.—*Caes. B. Civ. III., 16.*

VI. Latin Prose Composition.

1. Caesar sent Labienus to occupy (*occupo*) the top of the mountain near the camp of the enemy. 2. They marched for fourteen days continuously lest the Romans should capture (*capio*) the ford (*vadum*). 3. The Germans were brave, of great stature [translate size (*magnitudo*) of body] and used skins (*pellis*) as clothing (*vestitus*). 4. In the consulship of Lucius Piso and Aulus Gabinius, Caesar came from Rome to Geneva. 5. If he had been less brave he could never have conquered (*vinco*) the Helvetians. 6. Caesar said that Ariovistus had most eagerly (*cupidissime*) sought (*appeto*) the friendship (*amicitia*) of the Romans during his consulship; why should any one think that he would not do his duty (*officium*)?

VII. Roman History.

1. Give an account of how the Kingship came to an end in Rome, with the date of the expulsion of the kings.
2. State the main events in the struggle for power between the patricians and the plebeians.
3. Give the life of Marius.
4. Who fought the following battles and who were victorious: Mount Vesuvius, Cannae, Zama, Philippi, Actium?
5. Give the names and dates of the first five emperors.

IX.—GREEK.

I. Grammar.

1. Write the second person singular of the present and future indicative, and the third person singular and second person plural of the perfect indicative of the compound verb *ἀπο-ἱκνέομαι*, and state which rules of vowel and consonant change are illustrated.

2. *ὁ δὲ πείθεταί τε καὶ συλλαμβάνει*—which rules of accentuation are illustrated?

3. Decline through all numbers *λέαινα, νοῦς, ἐλπίς, ἀνήρ*; through the singular *ταμίας, κέρας, γυνή*.

4. Compare the adjectives *ταχύς, αἰσχρος, σώφρων.*

5. Give the principal parts of *γίγνομαι, γιγνώσκω;* the synopsis (*i. e.*, first form in each mode) of the aorist passive of *στέλλω:* the inflection through the numbers and persons of the present optative of *δίδωμι;* the present participle, nominative singular (three genders) of *ἵστημι* and *τιμάω.*

6. Name five prepositions that are used with the dative and give the meaning of each.

7. What is the difference in meaning between *οἶδα γράφειν* and *οἶδα γράφων?*

8. What is the difference in meaning between *εἰ τοῦτο ἐποίει, καλῶς ἂν ἐποίει,* and *εἰ τοῦτο ἐποίησε, καλῶς ἂν ἐποίησε?*

9. Translate into Greek: But since you do not wish to proceed with (me), it is of course necessary for me either to betray[1] you and avail-myself-of[2] the friendship of Cyrus or having lied to him to go with you. Whether now I shall do what is right I know not, but at any rate I will choose you and with you I will suffer whatever may be necessary.

[1] *προδίδωμι.*

[2] *χρῶμαι.*

II. Anabasis.

1. *Translate:*

ᾤετο δὲ ἀρκεῖν πρὸς τὸ ἀρχικὸν εἶναι καὶ δοκεῖν τὸν μὲν καλῶς ποιοῦντα ἐπαινεῖν, τὸν δὲ ἀδικοῦντα μὴ ἐπαινεῖν. τοιγαροῦν αὐτῷ οἱ μὲν καλοί τε κἀγαθοὶ τῶν συνόντων εὖνοι ἦσαν, οἱ δὲ ἄδικοι ἐπεβούλευον ὡς εὐμεταχειρίστῳ ὄντι. ὃτε δὲ ἀπέθνησκεν ἦν ἐτῶν ὡς τριάκοντα.

Construction of *δοκεῖν, ἐπαινεῖν, συνόντων, ἐτῶν?*

2. *Translate:*

πονηρὸν γὰρ νυκτός ἐστι στράτευμα Περσικόν. οἵ τε γὰρ ἵπποι αὐτοῖς δέδενται καὶ ὡς ἐπὶ τὸ πολὺ

πεποδισμένοι εἰσὶ, τοῦ μὴ φεύγειν ἕνεκα εἰ λυθείησαν. ἐάν τέ τις θόρυβος γίγνηται, δεῖ ἐπισάξαι τὸν ἵππον Πέρσῃ ἀνδρὶ, καὶ χαλινῶσαι δεῖ, καὶ θωρακισθέντα ἀναβῆναι ἐπὶ τὸν ἵππον. ταῦτα δὲ πάντα χαλεπὰ νύκτωρ καὶ θορύβου ὄντος.

Construction of *νυκτός, φεύγειν, λυθείησαν, γίγνηται*?

3. *Translate:*

αἱ δ' οἰκίαι ἦσαν κατάγειοι, τὸ μὲν στόμα ὥσπερ φρέατος, κάτω δ' εὐρεῖαι. αἱ δὲ εἴσοδοι τοῖς μὲν ὑποζυγίοις ὀρυκταὶ, οἱ δὲ ἄνθρωποι κατέβαινον ἐπὶ κλίμακος. ἐν δὲ ταῖς οἰκίαις ἦσαν αἶγες, οἶες, βόες, ὄρνιθες, καὶ τὰ ἔκγονα τούτων. τὰ δὲ κτήνη πάντα χίλῳ ἔνδον ἐτρέφετο.

III. Homer.

1. *Translate:*

Μῆτερ, ἐπεί μ' ἔτεκές γε μινυνθάδιόν περ ἐόντα, τιμήν πέρ μοι ὄφελλεν Ὀλύμπιος ἐγγυαλίξαι, Ζεὺς ὑψιβρεμέτης. νῦν δ' οὐδέ με τυτθὸν ἔτισεν. ἦ γάρ μ' Ἀτρεΐδης, εὐρὺ κρείων Ἀγαμέμνων, ἠτίμησεν. ἑλὼν γὰρ ἔχει γέρας, αὐτὸς ἀπούρας.

Where is *ἀπούρας* made? What is the present form? What is the present of *ἔτεκες*?

2. *Translate:*

Δαιμόνι', ἀτρέμας ἧσο καὶ ἄλλων μῦθον ἄκουε, οἵ σέο φέρτεροί εἰσι, σὺ δ' ἀπτόλεμος καὶ ἄναλκις. οὔτε ποτ' ἐν πολέμῳ ἐναρίθμιος οὔτ' ἐνὶ βουλῇ. οὐ μέν πως πάντες βασιλεύσομεν ἐνθάδ' Ἀχαιοί. οὐκ ἀγαθὸν πολυκοιρανίη. εἷς κοίρανος ἔστω, εἷς βασιλεύς, ᾧ ἔδωκε Κρόνου πάις ἀγκυλομήτεω.

Make a list of the forms peculiar to Homer and add the corresponding Attic forms. Derivation of *ἄναλκις, ἐναρίθμιος, πολυκοιρανίη*?

3. *Translate:*

Εὖτ' ὄρεος κορυφῆσι Νότος κατέχευεν ὀμίχλην,
ποιμέσιν οὔ τι φίλην, κλέπτῃ δέ τε νυκτὸς ἀμείνω,
τόσσον τίς τ' ἐπὶ λεύσσει, ὅσον τ' ἐπὶ λᾶαν ἵησιν.
ὣς ἄρα τῶν ὑπὸ ποσσὶ κονίσαλος ὦρνυτ' ἀελλὴς
ἐρχομένων. μάλα δ' ὦκα διέπρησσον πεδίοιο.

Mark the quantities and feet of these five lines.

IV. Sight Reading.

Ἵνα δὲ εἰδῆτε ὅτι οὐ καινὰ ταῦτα οὗτος ποιεῖ, ἀλλὰ φύσει προδότης ἐστίν, ἀναμνήσω ὑμᾶς τὰ τούτῳ πεπραγμένα. οὗτος γὰρ, ἐξ ἀρχῆς μὲν τιμώμενος ὑπὸ τοῦ δήμου κατὰ τὸν πατέρα Ἄγνωνα, προπετέστατος ἐγένετο τὴν δημοκρατίαν μεταστῆσαι εἰς τοὺς τετρακοσίους, καὶ ἐπρώτευεν ἐν ἐκείνοις. ἐπεὶ δ' ἤσθετο ἀντίπαλόν τι τῇ ὀλιγαρχίᾳ ξυνιστάμενον, πρῶτος αὖ ἡγεμὼν τῷ δήμῳ ἐπ' ἐκείνους ἐγένετο. ὅθεν δήπου καὶ κόθορνος ἐπικαλεῖται. καὶ γὰρ ὁ κόθορνος ἁρμόττειν μὲν τοῖς ποσὶν ἀμφοτέροις δοκεῖ, ἀποβλέπει δ' ἐπ' ἀμφότερον.

ἀντίπαλον = hostile. *ἀποβλέπειν* = to be adapted.
ἁρμόττειν = to fit. *καινός* = new.
κατά = after the manner of.
κόθορνος = buskin (a kind of shoe).
προπετής = eager.

V. History.

1. Describe the expedition of Xerxes against Greece.
2. Give a summary account of the Peloponnesian War.
3. Who was Epaminondas, and for what is he famous?
4. When was the battle of Chaeroneia fought? Where was Chaeroneia? Who were the combatants? What were the results?
5. What changes did Ephialtes and Pericles effect in the Athenian Constitution?

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